

Visual Narrative Elements in Eco-Toon Animation: A Conceptual Framework for Environmental Learning

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ABSTRACT:

Environmental issues continue to become increasingly complex, creating a growing need for educational approaches that are not only informative but also engaging and emotionally meaningful. In this context, animation has emerged as a promising medium for environmental learning due to its ability to combine visual storytelling, motion, and emotional expression. However, existing studies on eco-toon animation often focus primarily on message content while giving less attention to the visual mechanisms that influence learning processes. Therefore, this study explores the role of visual narrative elements in eco-toon animation as mechanisms that support environmental learning. Drawing upon the Cognitive Theory of Multimedia Learning (CTML) and visual communication studies, this paper proposes a conceptual framework referred to as the Visual Narrative Learning Model in Eco-Toon Animation. The framework explains how visual narrative elements such as sakuga, animation principles, and visual composition function as learning inputs that influence cognitive processing and emotional engagement. These processes subsequently contribute to environmental learning outcomes, including awareness, attitude, and behavioural intention. The study argues that visual narrative elements should not be viewed merely as aesthetic features, but as active mechanisms that guide attention, support meaning construction, and strengthen emotional connection with environmental issues. In addition, the paper highlights the integration of cognitive and emotional processes as an important factor in enhancing learning effectiveness through animation. Overall, this conceptual study contributes to multimedia learning and animation studies by shifting attention from message content to visual delivery mechanisms. It also provides practical implications for animators, educators, and content developers interested in designing more effective eco-toon animation for environmental communication and education.

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Introduction

Environmental issues such as climate change, pollution, and biodiversity loss continue to escalate at a global scale. Despite continuous awareness campaigns and formal education efforts, the level of environmental understanding among young people remains a concern. Many existing approaches rely heavily on text-based delivery or factual explanation, which often fails to create strong emotional engagement or long-term behavioural change. Research has shown that information-driven approaches alone are insufficient to influence environmental attitudes and behavioural intention, particularly when learners are not emotionally connected to the issue (Hofman-Bergholm, 2022; UNESCO, 2021; Otto & Pensini, 2017). This suggests that environmental education requires not only knowledge transmission, but also meaningful and engaging learning experiences that connect with learners on both cognitive and emotional levels.

In this context, animation has emerged as a promising medium for environmental learning. Animation integrates visual imagery, motion, sound, and narrative, allowing complex environmental concepts to be simplified and presented in a more accessible and engaging way. Compared to conventional learning materials, animation has the ability to stimulate dual processing through visual and auditory channels, which enhances attention, comprehension, and retention (Mayer, 2021; Liu & Chen, 2022). In addition, animation supports experiential learning by presenting environmental issues through stories, characters, and consequences, making abstract concepts more relatable to everyday experiences. Within environmental education, this approach is often referred to as *eco-toon*, where entertainment and education are combined to communicate environmental messages effectively (Cavallaro, 2021).

Eco-toon animation allows environmental issues to be framed as narratives rather than isolated facts. Through storytelling, viewers are able to

observe cause and effect relationships, such as the impact of human actions on ecosystems, which supports deeper understanding. At the same time, emotional engagement with characters and situations can foster empathy and concern towards environmental issues. Studies have suggested that emotionally engaging media content can strengthen environmental awareness and increase the likelihood of pro-environmental attitudes (Hofman-Bergholm, 2022; Green & Brock, 2000). This highlights the potential of animation not only as an informative tool, but also as a medium that can influence perception and motivation.

However, despite the recognised potential of animation in environmental learning, most existing studies tend to focus primarily on the message content itself. Research often examines environmental themes, narrative messages, or moral values conveyed through animation, while paying less attention to how these messages are visually constructed and delivered. In other words, the focus is largely on *what* is communicated, rather than *how* the message is visually presented. This creates a gap in understanding the role of visual narrative elements in shaping viewer attention, interpretation, and learning processes (Bateman, 2014; Forceville, 2016; Mayer, 2021).

Visual narrative elements, such as character movement, scene composition, emotional expression, and animation techniques, play a critical role in shaping how a story is experienced. Techniques such as *sakuga* are often used to highlight key moments through highly detailed and expressive animation, making them more noticeable and impactful (Denison, 2015). In addition, classical animation principles developed by Disney animators, including anticipation, staging, timing, and squash and stretch, contribute to clarity, emphasis, and visual understanding (Thomas & Johnston, 1981). These elements guide viewer attention, structure visual information, and enhance the overall readability of the narrative. Therefore, they should not be viewed solely as

aesthetic features, but as functional components that influence how information is perceived and interpreted.

From a learning perspective, the role of these visual elements can be explained through the Cognitive Theory of Multimedia Learning (CTML) proposed by Mayer (2021). CTML suggests that learning becomes more effective when information is presented through both visual and verbal channels in a structured manner, while also considering the limitations of cognitive capacity. One of the key principles within CTML is the signalling principle, which emphasises the use of cues to direct attention towards relevant information. In animation, visual narrative elements such as motion emphasis, composition, and contrast can function as signalling mechanisms that guide viewers to focus on important parts of a scene. This helps reduce cognitive overload and supports more efficient information processing. In addition, structured visual presentation can support the organisation of information, allowing viewers to form coherent mental representations of environmental concepts.

Beyond cognitive processing, emotional engagement also plays an important role in multimedia learning. Although CTML primarily focuses on cognitive mechanisms, recent studies suggest that emotional responses can enhance attention and memory, making learning more meaningful (Um et al., 2012; Plass & Kaplan, 2016). Animation, with its strong visual storytelling and expressive elements, is particularly effective in triggering emotional responses. In the context of environmental learning, emotional engagement is essential, as issues such as climate change and ecological damage often require empathy and personal reflection in order to influence attitudes and behavioural intention.

Despite this theoretical potential, there is still limited research that clearly explains how visual narrative elements function as integrated learning mechanisms in eco-toon animation. Existing studies rarely establish a structured

connection between visual storytelling techniques, cognitive processing, and environmental learning outcomes. As a result, the role of visual construction in supporting learning remains underexplored.

Therefore, this study aims to address this gap by examining the role of visual narrative elements as both cognitive and emotional mechanisms in environmental learning. Specifically, this study explores how visual narrative elements in eco-toon animation influence attention, cognitive processing, and emotional engagement. By integrating animation studies with the Cognitive Theory of Multimedia Learning, this study proposes a conceptual explanation of how visual elements contribute to environmental awareness and learning outcomes. In doing so, the study shifts the focus from message content to visual delivery mechanisms, positioning visual narrative elements as active components in the learning process rather than merely supporting features.

Literature Review

2.1 Cognitive Theory of Multimedia Learning in Animation

The Cognitive Theory of Multimedia Learning (CTML) explains how individuals process and understand information when it is presented through both visual and verbal forms. According to Richard E. Mayer, learning becomes more effective when learners actively select, organise, and integrate information from these two channels (Mayer, 2021). The theory is built on three key assumptions, which are dual channel, limited capacity, and active processing. These principles highlight that learners have separate channels for processing visual and auditory information, that each channel has limited capacity, and that meaningful learning requires active mental engagement.

In the context of animation, CTML is highly relevant because animation naturally combines visual motion, sound, and narrative. This multimodal structure allows information to be

processed more efficiently compared to text-based materials alone. Studies have shown that visual and narrative-based learning materials can enhance attention, comprehension, and retention, especially when the content is structured clearly (Liu & Chen, 2022). This makes animation a suitable medium for delivering complex concepts, including environmental issues, in a more accessible way.

One important concept within CTML is the signalling principle, which refers to the use of cues to highlight important information and guide learner attention. Visual cues such as movement, contrast, framing, or emphasis can help learners focus on key elements and reduce unnecessary cognitive load (Mayer, 2021). In animation, these cues are often embedded within the visual design itself, such as through exaggerated motion, scene composition, or character expression. This suggests that visual narrative elements in animation can function as signalling mechanisms that support cognitive processing.

Another relevant aspect of CTML is active processing, where learners are not passive receivers of information but actively construct meaning from what they see and hear. In animation, storytelling and visual sequences can encourage viewers to interpret events, connect ideas, and form understanding based on the narrative flow. This becomes especially important in environmental learning, where understanding is not only about facts but also about recognising relationships between human actions and ecological consequences.

In addition, emotional engagement plays an indirect but important role in multimedia learning. Although CTML focuses mainly on cognitive processes, recent studies suggest that emotional responses can enhance attention and memory, making learning more meaningful (Hofman-Bergholm, 2022). Animation, with its expressive visuals and narrative structure, is particularly effective in triggering emotional responses, which can strengthen the learning experience.

2.2 Animation as a Medium for Environmental Learning

Animation has increasingly been recognised as an effective tool for education, particularly in delivering complex or abstract concepts. Its ability to combine visual storytelling with emotional engagement allows it to capture audience attention and sustain interest more effectively than traditional text-based materials. By integrating motion, sound, and narrative, animation presents information in a dynamic and accessible way, making it easier for learners to understand and retain knowledge (Mayer, 2021; Liu & Chen, 2022). In environmental education, animation is often used to communicate issues such as climate change, pollution, and conservation in a form that is more relatable to everyday experiences (Cavallaro, 2021).

The concept of eco-toon refers to the use of animation that integrates environmental messages with entertainment elements. This approach aligns with the broader concept of edutainment, where learning is embedded within engaging and narrative-driven content. Eco-toon enables environmental issues to be presented not merely as factual information, but as stories involving characters, conflicts, and consequences. Through this narrative structure, viewers are able to observe cause-and-effect relationships and develop a deeper understanding of environmental issues. At the same time, storytelling allows viewers to form emotional connections with the characters and situations, which can enhance empathy and concern towards environmental problems (Green & Brock, 2000; Hofman-Bergholm, 2022).

Research has shown that visual storytelling plays a significant role in influencing both cognitive understanding and emotional response, which are key components in environmental learning. When learners are emotionally engaged, they are more likely to reflect on the message, internalise its meaning, and relate it to their own experiences. This is particularly important in

environmental education, where behavioural change often depends on both knowledge and emotional motivation (Otto & Pensini, 2017). In addition, recent studies in multimedia learning suggest that emotionally engaging visual content can enhance attention and memory retention, leading to more meaningful learning outcomes (Schneider et al., 2021).

However, despite these recognised benefits, many existing studies on animation in education still focus primarily on the effectiveness of the message itself rather than the mechanisms used to deliver it. Research often evaluates the impact of environmental themes or narrative content, while giving less attention to how specific visual techniques shape understanding and engagement. As a result, there is limited discussion on how animation functions at a deeper level, particularly in terms of visual narrative construction. This suggests a need for further investigation into how visual elements operate as active components in the learning process, rather than simply supporting the delivery of content.

2.3 Visual Narrative Elements in Animation

Visual narrative elements refer to the components within animation that shape how a story is visually presented and understood. These include character movement, scene composition, timing, visual emphasis, and emotional expression. Together, these elements guide the viewer's attention and influence how the narrative is interpreted. Unlike static visual media, animation presents meaning through continuous motion and temporal sequencing, allowing information to unfold dynamically over time. This makes visual narrative elements especially important, as they determine not only what is seen, but also how it is perceived, organised, and processed by the viewer (Bateman, 2014; Forceville, 2016; Cohn, 2020).

In addition, these elements do not function independently, but work together to shape the overall viewing experience. Movement, composition, and visual emphasis interact to direct attention, highlight important

information, and support understanding. As a result, visual narrative elements play a key role in connecting visual presentation with cognitive and emotional responses in animation-based learning.

2.3.1 Sakuga and Visual Emphasis in Animation

One important concept in animation is *sakuga*, which refers to scenes that are given special attention in terms of animation quality and detail. These scenes often feature fluid motion, strong emotional expression, and dynamic composition. *Sakuga* is typically used to highlight key narrative moments, making them more impactful and memorable (Denison, 2015). Because of its high visual intensity, *sakuga* often stands out from surrounding scenes, naturally drawing the viewer's attention to important parts of the story.

From a learning perspective, such scenes can function as attention-directing mechanisms that signal important information to the viewer. The heightened visual intensity draws focus to specific actions or emotional cues, supporting selective attention and reinforcing key messages within the narrative. This aligns with multimedia learning research, where visual emphasis and dynamic cues are shown to enhance attention and memory retention (Schneider et al., 2021). In addition, emotionally expressive *sakuga* scenes can strengthen viewer engagement, making the message more meaningful and easier to remember.

In this sense, *sakuga* can be understood not only as an aesthetic enhancement, but also as a functional element that supports attentional processes and emotional engagement in animation-based learning.

2.3.2 Disney Animation Principles and Visual Clarity

In addition to *sakuga*, the principles of animation developed by Disney animators, such as anticipation, staging, timing, and squash and stretch, play a crucial role in shaping visual

clarity and comprehension (Thomas & Johnston, 1981). These principles are designed to make movement more readable and actions easier to interpret, helping viewers follow the narrative more smoothly.

For example, anticipation prepares the viewer for an upcoming action, allowing them to expect and understand what is about to happen. Staging ensures that the most important elements within a scene are clearly visible and not distracted by unnecessary details. Timing controls the speed and rhythm of movement, influencing how actions are perceived and how easily they can be understood. Squash and stretch further enhance clarity by exaggerating motion, making actions appear more natural and expressive.

Together, these principles help organise visual information in a structured way that aligns with how viewers process motion and meaning. This is supported by research in animation and cognitive processing, which shows that well-structured motion and visual organisation can reduce cognitive load and improve comprehension (Bétrancourt & Tversky, 2021). When visual information is presented clearly, viewers can focus more on understanding the message rather than trying to interpret confusing visuals.

Therefore, these principles can be understood as cognitive support mechanisms that facilitate clearer interpretation and more effective learning in animation-based content.

2.3.3 Visual Composition and Environmental Meaning

Visual composition also plays a critical role in conveying meaning within animation. Elements such as framing, colour, spatial arrangement, and environmental design influence how a scene is interpreted. In eco-toon animation,

environmental features such as forests, water, weather, and wildlife are often used as symbolic representations of ecological conditions and relationships. These visual cues allow complex environmental concepts to be communicated in a more intuitive and accessible manner.

Research in visual communication suggests that multimodal representations enhance meaning-making by linking abstract ideas with concrete visual forms (Kress & van Leeuwen, 2006; Lester, 2021). Through this process, viewers are able to interpret environmental relationships not only cognitively, but also through visual association and contextual understanding.

From the perspective of multimedia learning, these visual narrative elements can be understood as functional tools that support both attention and cognitive processing. By guiding focus, reducing ambiguity, and emphasising key information, these elements contribute to more effective comprehension. At the same time, expressive visuals and dynamic scenes can evoke emotional responses, which further strengthen engagement and memory retention (Schneider et al., 2021; Moreno & Mayer, 2022). This dual role highlights that visual narrative elements operate at both cognitive and emotional levels, making them essential components in animation-based learning.

However, despite their importance, the relationship between specific visual narrative techniques and learning outcomes remains underexplored, particularly in the context of environmental education. Most existing studies focus on narrative content rather than visual construction. This suggests a need for further research that examines how these visual elements function as active mechanisms in shaping attention, interpretation, and environmental understanding.

3. Proposed Conceptual Framework

3.1 Conceptual Model of Visual Narrative Elements in Eco-Toon Animation

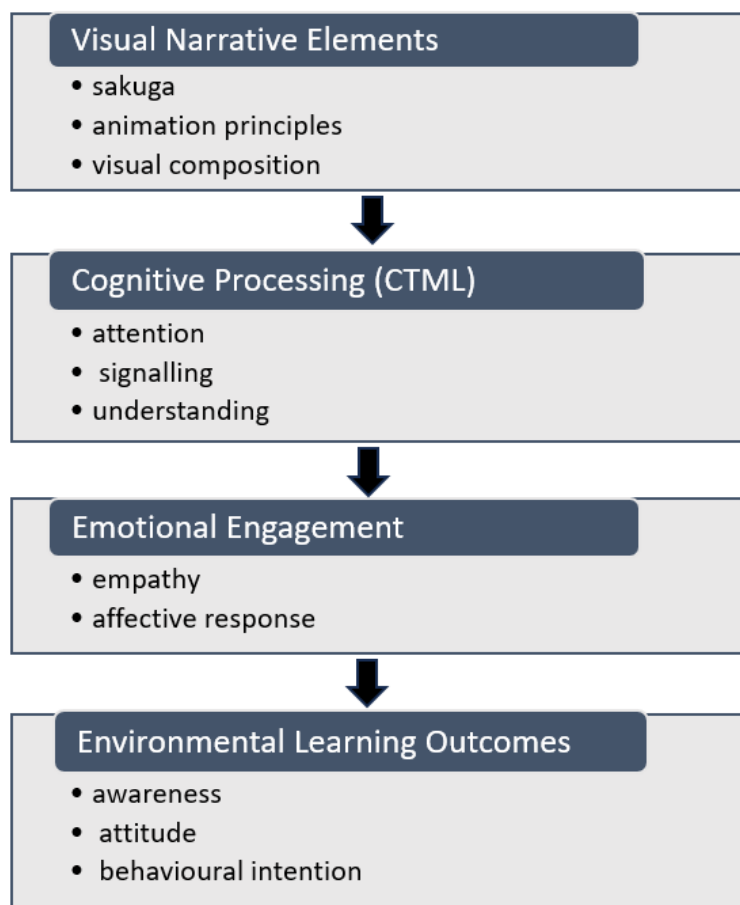


Figure 1. Visual Narrative Learning Model in Eco-Toon Animation showing the relationship between visual narrative elements, cognitive processing, emotional engagement, and environmental learning outcomes

This study proposes a conceptual framework that explains how visual narrative elements in eco-toon animation contribute to environmental learning. This conceptual model, referred to as the *Visual Narrative Learning Model in Eco-Toon Animation*, is informed by established theories in multimedia learning and visual communication, with a focus on how visual construction supports both cognitive processing and emotional engagement. Rather than emphasising content alone, the model highlights the role of visual elements as active mechanisms that influence how information is presented, interpreted, and understood by viewers.

The model positions visual narrative elements as primary inputs that shape the learning experience. These elements include animation techniques such as *sakuga*, the application of animation principles, and the use of visual composition and environmental symbolism. Each component plays a distinct role in guiding viewer perception. For example, *sakuga* highlights key moments and draws attention, animation principles improve clarity and readability of motion, while visual composition supports meaning through spatial arrangement and symbolic representation. Together, these elements determine how information is

structured and emphasised within an animated narrative.

These visual inputs influence cognitive processing, which is explained through the Cognitive Theory of Multimedia Learning (CTML). Visual elements act as signals that guide attention, support the organisation of information, and facilitate understanding. Clear and well-structured visuals help reduce unnecessary cognitive load, allowing viewers to focus on key messages and form coherent mental representations of environmental concepts.

At the same time, visual narrative elements contribute to emotional engagement. Expressive scenes, character reactions, and environmental storytelling can evoke empathy and affective responses. This emotional connection strengthens attention and memory, making the learning experience more meaningful.

The model further suggests that environmental learning outcomes, including awareness, attitude, and behavioural intention, are influenced by the interaction between cognitive processing and emotional engagement. When viewers both understand the message clearly and feel emotionally connected to it, they are more likely to develop deeper awareness and a stronger willingness to adopt sustainable behaviours.

Overall, this conceptual framework provides a structured explanation of how visual narrative elements function as key mechanisms in animation-based environmental learning.

3.2 Visual Narrative Elements as Learning Inputs

Visual narrative elements form the foundation of the proposed conceptual model. In animation, these elements determine how a story is visually constructed and how meaning is communicated to the audience. They act as the main inputs that shape how viewers perceive, interpret, and engage with the content.

Techniques such as *sakuga*, which emphasise high-quality and expressive animation in key scenes, serve to highlight important narrative moments and direct viewer attention. These scenes often stand out due to their visual intensity, making them effective in guiding focus towards critical actions or emotional cues. Similarly, animation principles such as anticipation, staging, timing, and squash and stretch help to improve clarity and make actions easier to follow. By structuring movement in a clear and organised way, these principles support better understanding and reduce confusion during viewing.

In addition, visual composition, including framing, colour, spatial arrangement, and environmental design, plays an important role in conveying meaning. In eco-toon animation, natural elements such as forests, water, weather, and wildlife are often used as visual symbols to represent environmental themes. These elements help viewers interpret complex ecological relationships in a more intuitive and engaging way.

Overall, visual narrative elements are not only aesthetic features, but also functional components that guide attention, support interpretation, and shape how information is understood within an animated narrative.

3.3 Cognitive Processing Based on CTML

The second component of the framework focuses on cognitive processing, which is explained through the Cognitive Theory of Multimedia Learning (CTML) (Mayer, 2021). According to this theory, learning occurs when individuals actively process information through both visual and verbal channels. In animation, this process is supported by the way visual narrative elements are designed and presented.

Within this framework, visual narrative elements function as signals that guide viewer attention and support the organisation of information. Elements such as emphasised movement, clear staging, and visual contrast help direct attention

to important parts of a scene while reducing unnecessary cognitive load. This aligns with the signalling principle in CTML, where cues are used to highlight key information and make it easier for learners to focus on what is important.

In addition, structured visual presentation supports the organisation and integration of information. When scenes are visually clear and well arranged, viewers are able to form coherent mental representations of the content. This is particularly important in environmental learning, where viewers need to understand relationships between human actions and ecological consequences.

Through this process, visual narrative elements contribute to more effective comprehension. By guiding attention, reducing confusion, and supporting meaning construction, these elements help viewers process environmental messages more efficiently and meaningfully within the animated narrative.

3.4 Emotional Engagement as a Mediating Factor

Beyond cognitive processing, emotional engagement plays a critical role in environmental learning. Animation has a unique ability to evoke emotions through character expression, narrative conflict, and visual storytelling. When viewers feel emotionally connected to a story, they are more likely to reflect on the message and internalise its meaning.

In eco-toon animation, emotional engagement can be triggered through scenes that depict environmental damage, human impact on nature, or the consequences of ecological imbalance. These scenes allow viewers to not only understand environmental issues, but also to feel concern and empathy towards them. Visual narrative elements enhance this process by making such scenes more expressive, dynamic, and impactful. As a result, emotional responses such as empathy, concern, and reflection can be strengthened.

Within the proposed model, emotional engagement functions as a mediating factor between cognitive processing and environmental learning outcomes. While cognitive processing supports understanding, emotional engagement deepens the viewer's connection to the message. When viewers both understand the issue and feel emotionally involved, the learning experience becomes more meaningful and memorable.

This interaction helps strengthen attention and memory, and increases the likelihood that viewers will develop stronger awareness and more positive attitudes towards environmental issues. Therefore, emotional engagement plays an important role in supporting more effective environmental learning through animation.

3.5 Environmental Learning Outcomes

The final component of the framework focuses on environmental learning outcomes, which include awareness, attitude, and behavioural intention. These outcomes represent the intended effects of eco-toon animation as an educational medium. Awareness refers to the viewer's understanding of environmental issues, including knowledge of causes, impacts, and possible solutions. Attitude reflects how viewers perceive and evaluate these issues, including their level of concern and sense of responsibility. Behavioural intention relates to the willingness to take action or adopt more sustainable practices.

Within the proposed model, these outcomes are influenced by both cognitive processing and emotional engagement. Cognitive processing supports the viewer's ability to understand environmental information clearly, while emotional engagement strengthens personal connection to the message. When viewers are able to both understand the issue and feel emotionally connected to it, the learning experience becomes more meaningful and impactful.

This interaction increases the likelihood of developing deeper awareness and more positive attitudes towards environmental issues. In turn, this can lead to stronger behavioural intention, such as the willingness to adopt environmentally responsible behaviours. However, it is important to note that actual behaviour may still be influenced by external factors, such as social context, personal values, and available resources.

Overall, environmental learning outcomes represent the combined effect of cognitive and emotional processes in shaping more effective and meaningful learning through eco-toon animation.

3.6 Summary of the Framework

Overall, the proposed conceptual framework highlights the role of visual narrative elements as active components in the learning process. By linking animation techniques with cognitive processing and emotional engagement, the model provides a structured explanation of how eco-toon animation can support environmental learning. Rather than focusing only on content delivery, the framework emphasises how visual elements guide attention, support understanding, and enhance emotional connection.

The framework also demonstrates how different components work together in a continuous process. Visual narrative elements act as inputs, cognitive processing supports understanding, and emotional engagement strengthens the viewer's connection to the message. These processes together contribute to environmental learning outcomes, including awareness, attitude, and behavioural intention.

Overall, this perspective offers a clearer understanding of how animation can function as an effective educational tool, particularly in communicating environmental issues in a more engaging and meaningful way.

4. Discussion

4.1 Visual Narrative Elements as Learning Mechanisms

This study highlights that visual narrative elements in animation should not be viewed merely as aesthetic components, but as functional mechanisms that support learning. While previous studies often emphasise the importance of content in environmental communication, the findings of this conceptual analysis suggest that the way content is visually delivered plays an equally critical role. Elements such as motion, composition, and expressive scenes act as signals that guide viewer attention and influence how information is processed and understood.

From the perspective of multimedia learning, these elements function as part of the signalling process, where important information is visually emphasised to reduce cognitive overload and improve comprehension (Mayer, 2021). Visual cues such as movement, contrast, and scene composition help direct attention to key parts of a narrative, allowing viewers to focus on relevant information. This supports more efficient cognitive processing, particularly in complex topics such as environmental issues.

For example, techniques such as *sakuga*, which highlight key narrative moments through detailed and dynamic animation, can draw attention to important environmental messages. These visually intense scenes help viewers identify critical points within the story, making the message more noticeable and memorable. Similarly, animation principles such as staging and timing help organise visual information in a structured way, making actions easier to follow and interpret. When visual information is presented clearly, viewers can process meaning more effectively without unnecessary confusion.

This suggests that visual narrative elements are not passive design choices, but active tools that shape how learning takes place. By guiding attention, structuring information, and

emphasising key messages, these elements support both understanding and engagement. As a result, the effectiveness of eco-toon animation depends not only on what is communicated, but also on how the message is visually constructed and delivered.

4.2 Integration of Cognitive and Emotional Processes

Another key contribution of this study is the integration of cognitive and emotional processes in understanding environmental learning through animation. While the Cognitive Theory of Multimedia Learning focuses primarily on how information is processed cognitively, this study extends the discussion by incorporating the role of emotional engagement as an essential component of the learning experience.

Environmental issues are not purely informational topics. They often require empathy, reflection, and personal connection in order to influence attitudes and behavioural intention. Visual storytelling in animation creates opportunities for viewers to engage emotionally with the narrative. Scenes that depict environmental destruction, human impact, or ecological imbalance can trigger emotional responses such as concern, empathy, and reflection. These responses are further strengthened when visual narrative elements enhance the clarity and intensity of the scene, making the message more impactful.

From a learning perspective, cognitive processing and emotional engagement work together rather than independently. Cognitive processing helps viewers understand the message, while emotional engagement strengthens their connection to it. When viewers are able to interpret information clearly and at the same time feel emotionally involved, the learning experience becomes more meaningful and memorable. This interaction supports deeper reflection and increases the likelihood of internalising environmental messages.

This finding aligns with previous research that highlights the importance of emotional engagement in strengthening learning outcomes, particularly in environmental education (Hofman-Bergholm, 2022; Schneider et al., 2021). It suggests that effective environmental communication should not rely on information alone, but also consider how emotional responses can support learning. Therefore, the integration of cognitive and emotional processes provides a more complete explanation of how eco-toon animation can influence environmental awareness and attitudes.

4.3 Implications for Eco-Toon Design

The proposed conceptual framework provides practical implications for the design of eco-toon animation. Rather than focusing only on delivering environmental messages, animators and content creators should consider how visual narrative elements can be used strategically to support learning. This includes careful use of motion, composition, timing, and emotional expression to guide viewer attention, improve understanding, and strengthen engagement.

One key implication is the use of visual emphasis to highlight important environmental messages. Key moments in the narrative can be designed with stronger visual impact, where motion, character expression, and scene composition are enhanced to draw attention. Techniques such as *sakuga* can be applied in these moments to create visual contrast between ordinary and important scenes, making critical messages more noticeable and memorable.

In addition, animation principles such as staging and timing can be used to improve clarity and support comprehension. Staging ensures that important elements are clearly visible and not distracted by unnecessary details, while timing controls the speed and rhythm of movement. When pacing is well managed, viewers are able to follow the narrative more easily and process information without confusion. This is particularly important in environmental

storytelling, where complex cause-and-effect relationships need to be communicated clearly.

Visual composition also plays an important role in conveying environmental meaning. Elements such as colour, framing, and environmental design can be used to represent ecological conditions and relationships. For example, changes in colour tone or background setting can signal environmental damage or recovery. Natural elements such as forests, water, and wildlife can be used as visual symbols to communicate ecological themes in a more intuitive way, allowing viewers to understand the message without relying heavily on verbal explanation.

This approach shifts the focus from simply “what message to deliver” to “how the message is visually constructed.” By designing visual elements with clear purpose, eco-toon animation can become a more effective medium for environmental education. It allows viewers not only to understand environmental issues, but also to feel connected to them. This is particularly relevant for younger audiences, who are generally more responsive to visual and narrative-based content.

Overall, the framework highlights that effective eco-toon design depends on the integration of visual clarity, emotional engagement, and meaningful storytelling. When these elements are combined strategically, animation can serve as a powerful tool for communicating environmental messages in a way that is both engaging and impactful.

4.4 Contribution to Existing Literature

This study contributes to the existing body of knowledge by offering a more detailed understanding of how animation supports environmental learning. While previous research has established that animation can be an effective educational tool, there is still limited explanation of the underlying mechanisms that drive this effectiveness. Most studies tend to focus on the content of environmental

messages, such as themes, narratives, and moral values, rather than examining how these messages are visually constructed and delivered.

By focusing on visual narrative elements, this study provides a clearer link between animation techniques and learning processes. It highlights how elements such as motion, composition, and expressive scenes function as mechanisms that guide attention, support understanding, and influence interpretation. In this context, visual elements are positioned not as supporting features, but as active components that shape how learning takes place. This perspective helps explain how viewers process environmental information more effectively within animated narratives.

In addition, this study contributes by integrating cognitive and emotional processes within a single framework. While the Cognitive Theory of Multimedia Learning has been widely used to explain how information is processed, its application in animation studies has often focused mainly on cognitive aspects. This study extends the discussion by emphasising the role of emotional engagement as an important factor that works alongside cognitive processing to strengthen learning outcomes.

Furthermore, this study addresses a gap in existing research that tends to prioritise content over delivery mechanisms. By shifting attention towards visual construction, it offers a new direction for future research that explores how specific animation techniques can influence learning outcomes in more detailed and measurable ways. This opens opportunities for further studies to test and refine the proposed relationships across different contexts and audiences.

4.5 Limitations and Future Research

As a conceptual study, this paper is limited by the absence of empirical data. The proposed framework is based on theoretical integration and literature analysis, and therefore requires further validation through empirical research.

While the framework provides a structured explanation of how visual narrative elements may influence learning, its effectiveness has not yet been tested in real-world settings. Future studies can address this limitation by examining how different visual narrative elements influence attention, emotional engagement, and environmental learning outcomes among viewers.

In addition, future research can explore how different types of animation content and presentation styles affect learning outcomes. For example, variations in animation style, pacing, or level of visual detail may influence how viewers process information and respond emotionally. Experimental or survey-based studies can be used to test these factors and provide more concrete evidence to support the proposed relationships.

Another important direction for future research is the role of cultural context. Environmental understanding is often shaped by local experiences, values, and beliefs. Incorporating culturally relevant elements into visual narratives may enhance viewer engagement and make the message more meaningful. Future studies can explore how cultural factors influence the effectiveness of eco-toon animation across different audiences.

Overall, further research is needed to test, refine, and extend the proposed framework in different contexts. This will help strengthen its applicability and provide a deeper understanding of how animation can be used more effectively in environmental education.

5. Implications

5.1 Theoretical Implications

This study contributes to the theoretical development of multimedia learning and animation studies by extending the application of the Cognitive Theory of Multimedia Learning (CTML) into the context of visual storytelling. While CTML has been widely used to explain how individuals process multimedia

information, its application in animation research has often focused mainly on general visual and verbal integration. This study advances the discussion by highlighting how specific visual narrative elements function as signalling mechanisms that guide attention, support interpretation, and facilitate meaning construction.

In addition, this study provides a more integrated perspective by linking cognitive processing with emotional engagement. Traditional applications of CTML tend to emphasise cognitive aspects of learning, such as attention, organisation, and information processing. However, this study argues that emotional responses triggered through visual storytelling also play an important role in shaping the learning experience, particularly in environmental learning contexts. By positioning visual narrative elements as both cognitive and emotional drivers, this study offers a more holistic explanation of how learning occurs through animation.

Furthermore, this study contributes to existing literature by shifting attention from message content to visual delivery mechanisms. Previous studies have commonly focused on environmental themes and narrative messages, while giving less attention to how visual construction influences understanding and engagement. By focusing on visual narrative elements such as *sakuga*, animation principles, and visual composition, this study provides a more detailed explanation of how animation techniques can influence learning processes.

Taken together, the proposed conceptual framework contributes to a clearer theoretical understanding of how visual narrative elements support environmental learning through animation. It also provides a foundation for future research that can further examine and validate the relationships between visual storytelling, cognitive processing, emotional engagement, and learning outcomes.

5.2 Practical Implications

From a practical perspective, the findings of this study provide useful insights for animators, educators, and content developers involved in environmental communication. The study suggests that the effectiveness of eco-toon animation depends not only on the message itself, but also on how the message is visually constructed and presented. Visual narrative elements such as motion, composition, emotional expression, and environmental symbolism can influence how viewers pay attention to, interpret, and emotionally connect with environmental content.

- **For animators**

This study highlights the importance of using visual narrative elements strategically to support learning and engagement. Greater attention should be given to motion emphasis, scene composition, pacing, and character expression when designing eco-toon content. Techniques such as *sakuga* can be applied to highlight important narrative moments and direct viewer attention towards key environmental messages. At the same time, animation principles such as staging and timing can improve visual clarity and help audiences follow the narrative more easily. These design choices can help make environmental messages more visible, memorable, and emotionally impactful.

- **For educators**

The findings demonstrate the potential of animation as a teaching tool that supports both cognitive and emotional learning. Eco-toon animation can be integrated into classroom activities or environmental awareness programmes to encourage student engagement and deeper understanding of environmental issues. By selecting or designing

animation content that makes effective use of visual storytelling, educators may create learning experiences that are more interactive and meaningful. In addition, visual narrative elements can help simplify complex ecological relationships, making environmental topics easier for learners to understand and relate to everyday life.

- **For content developers and media producers**

This study encourages a shift in focus from message delivery to visual communication strategy. Environmental content can become more effective when supported by strong visual storytelling that connects with viewers on both cognitive and emotional levels. Elements such as visual symbolism, expressive scenes, and clear visual organisation can strengthen audience engagement and improve message retention. This approach is especially relevant for younger audiences, who are generally more responsive to visual and narrative-based media. By combining educational content with engaging visual presentation, eco-toon animation has the potential to communicate environmental messages in a more meaningful and impactful way.

6. Conclusion

This study explored the role of visual narrative elements in eco-toon animation as mechanisms that support environmental learning. By integrating insights from animation studies and the Cognitive Theory of Multimedia Learning, the study proposed a conceptual framework that explains how visual elements influence attention, cognitive processing, emotional engagement, and environmental learning outcomes.

The findings suggest that visual narrative elements such as motion, composition, and expressive storytelling are not merely aesthetic

features, but active components in the learning process. These elements function as signals that guide attention, reduce cognitive load, and support understanding, while also triggering emotional responses that strengthen engagement with environmental issues. The interaction between cognitive and emotional processes is identified as an important factor in enhancing environmental awareness and shaping attitudes.

In addition, this study contributes to existing literature by shifting attention from message content to visual delivery mechanisms in animation. It provides a clearer understanding of how eco-toon animation can be designed to support learning through strategic use of visual narrative elements. The proposed conceptual framework also offers a foundation for future research that can further examine the relationship between visual storytelling, cognitive processing, emotional engagement, and environmental learning outcomes.

As a conceptual study, the framework still requires further validation through empirical investigation. Future studies can explore how different visual narrative elements influence learning outcomes across various contexts and audiences. In addition, examining the role of cultural factors may provide further insights into how animation can be adapted to improve relevance and engagement in environmental communication.

Taken together, this study emphasises that effective environmental learning through animation depends not only on what is communicated, but also on how the message is visually constructed. By recognising the importance of visual narrative elements, eco-toon animation can be developed as a more engaging and meaningful tool for promoting environmental awareness and understanding.

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