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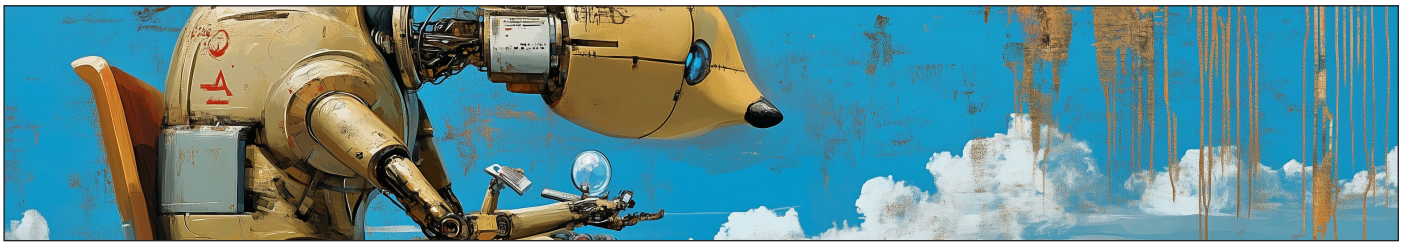

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Evaluating "Reading Bear": An analysis of a multimedia phonics programme using Mayer's principles of multimedia learning

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Abstract

This study evaluates Reading Bear (RB), a multimedia phonics programme, using Mayer's 12 principles of multimedia learning to assess its design for phonics instruction. The results suggest that RB aligns well with key principles such as spatial contiguity, segmenting, and multimedia integration, effectively supporting phonics learning by combining visuals and audio in a structured format. However, partial adherence to the redundancy, personalisation, and modality principles suggests areas for improvement, such as reducing redundant text, adopting a conversational tone, and adjusting audio pacing. These refinements could enhance the pedagogical impact of RB, making it a more adaptable tool for young learners. This analysis provides useful insights for schools, educational administrators, teachers, and policymakers considering the implementation of phonics programmes in different learning contexts. Future research could further explore the usability of RB through quantitative analysis, large-scale research and comparative studies.

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1. Introduction

Phonics instruction has long been central to early literacy education in English-speaking contexts (Ehri, 2020; Shanahan & Lonigan, 2010). It is a structured teaching method that facilitates reading and spelling by systematically associating letters (graphemes) with sounds (phonemes), enabling students to decode words by identifying and blending individual sounds (de Graaff et al., 2009). As digital technology has permeated classrooms, diverse digital tools e.g. augmented reality-based (Chen, 2018; Mahayuddin & Mamat, 2019) applications have emerged as significant resources for enhancing phonics instruction. However, only by implementing and aligning solid pedagogy can digital tools truly enhance teaching and learning (e.g., Børte & Lillejord, 2024; Lan, 2021).

Richard Mayer's 12 multimedia learning principles provide a robust pedagogical foundation that is highly influential in teaching and learning practices (Butcher, 2014). The multimedia principles refer to the finding that learning with words and pictures is more effective than learning with words alone (Mayer, 2014b). These principles provide a research-based framework for designing educational content that maximises cognitive processing and minimises overload (Mayer, 2014b). By adhering to these principles, educators and designers could create multimedia resources that are more likely to facilitate effective learning.

According to the introduction itself [Reading Bear (RB), n.d.], RB (**https://www.readingbear.org**) is an open-access, web-based resource developed by the St. Charles Place Education Foundation. The programme's design systematically teaches phonics rules by integrating words, images, and sounds, with each unit focusing on specific letter-sound relationships. This approach potentially aligns with Mayer's multimedia learning principles, positioning it as a representative case for evaluating multimedia applications in phonics education (Mayer, 2014b). While RB is freely available and widely accessible, the extent to which it aligns with established multimedia learning principles remains unexamined in no studies.

Therefore, this research aims to evaluate the multimedia phonics programme RB by analysing its design and examining its alignment with Mayer's 12 multimedia learning principles. Rather than promoting RB, this study seeks to provide a critical and objective assessment of its instructional design, focusing on the following research questions:

1. To what extent does RB adhere to Mayer's multimedia learning principles?
2. How effective is the design of RB in supporting phonics learning according to these principles?

This study is intended to provide insights for schools, educational administrators, teachers and policymakers involved in phonics programmes. By examining RB's alignment with Mayer's multimedia learning principles, it reveals the strengths and limitations of RB, offering valuable references for selecting digital literacy tools.

2. Literature review

2.1 Phonics instruction and multimedia learning

Phonics instruction is widely recognised as an essential approach for developing foundational literacy skills, especially for young and novice learners (de Graaff et al., 2009; Wyse & Goswami, 2008). It teaches learners the relationship between letters and sounds, enabling them to decode unfamiliar words and improve reading fluency (de Graaff et al., 2009). Recent advancements in digital learning have led to the integration of technologies to make phonics instruction more interactive and engaging (e.g., Chen, 2018; Mahayuddin & Mamat, 2019; O'Brien et al., 2022).

Multimedia learning theory suggests that when designed well, multimedia resources could support cognitive processes by presenting information through multiple channels, such as visual and auditory (Mayer, 2014b). By engaging more than one cognitive channel, multimedia resources could enhance memory retention and facilitate the processing of new information, both of which are vital in phonics learning. Multimedia tools in phonics instruction could present phonetic patterns with visuals and sounds that reinforce each other, offering a potentially powerful alternative to traditional methods (O'Brien et al., 2022).

2.2 Mayer's 12 principles of multimedia learning

Richard Mayer's multimedia learning theory provides a set of 12 principles designed to guide the effective design of multimedia educational content (see Table 1). Each principle serves a specific purpose to enhance learning by reducing extraneous cognitive load, fostering meaningful processing, and leveraging the dual-channel capacity of the human brain (Mayer, 2014a). By applying these principles, educational content designers might create resources that enhance understanding, minimise distractions, and improve retention.

Table 1. Mayer's 12 Principles of Multimedia Learning

No.	Principle	Description	Reference
1	Coherence principle	People learn better when they remove extra words, images, and voices.	(Mayer & Fiorella, 2014)
2	Signalling principle	People learn better when cues are added that highlight the organisation of the essential material.	(van Gog, 2014)
3	Redundancy principle	People learn better from graphics and narration than from graphics, narration, and on-screen text.	(Kalyuga & Sweller, 2014)
4	Spatial contiguity principle	People learn better when corresponding words and pictures are presented near rather than far from each other.	(Mayer & Fiorella, 2014)
5	Temporal contiguity principle	People learn better when corresponding words and pictures are presented simultaneously rather than successively.	(Ayres & Sweller, 2014; Mayer & Fiorella, 2014)
6	Segmenting principle	People learn better from a multimedia lesson presented in user-paced segments rather than as a continuous unit.	(Mayer & Pilegard, 2014)
7	Pre-training principle	People learn better from a multimedia lesson when they know the names and characteristics of the main concepts.	(Mayer & Pilegard, 2014)
8	Modality principle	People learn better from graphics and narrations than from animation and on-screen text.	(Low & Sweller, 2014)
9	Multimedia principle	People learn better from words and pictures than from words alone.	(Butcher, 2014)
10	Personalisation principle	People learn better from multimedia lessons when words are in conversational style rather than formal style.	(Mayer, 2014c)
11	Voice principle	People learn better when the narration in multimedia lessons is spoken in a friendly human voice rather than a machine voice.	(Mayer, 2014c)
12	Image principle	People do not necessarily learn better from a multimedia lesson when the speaker's image is added to the screen.	(Mayer, 2014c)

2.3 This study

The choice of RB as the focus of this study stems from its unique position as a free, accessible multimedia tool specifically designed for early phonics instruction. RB integrates images, audio, and interactive elements, potentially aligning closely with Mayer's multimedia learning principles and making it feasibly a representative case for evaluating multimedia applications in phonics instruction (Mayer, 2014a, 2014b). Its design conceivably could offer young learners an engaging and interactive platform for phonics practice, allowing them to associate sounds with visual and textual representations in a systematic manner. Thus, this combination of accessibility, interactivity, and alignment with Mayer's multimedia learning principles makes RB an ideal subject for this analysis. This study aims to evaluate the multimedia phonics program RB by analysing its design and examining its alignment with Mayer's 12 multimedia learning principles.

3. Methods

3.1 Research design

To assess each of Mayer's principles in RB, a structured evaluation checklist based on Mayer's multimedia learning principles was developed (see Appendix A). This checklist guided a detailed, objective analysis of RB's presentation of phonics content, focusing on the coherence of visual and auditory information, sequencing of phonetic concepts, and interactive elements for engaging young learners.

3.2 Data collection

The data collection process involved selecting some representative samples of phonics presentations within RB to ensure a comprehensive evaluation across various phonetic rules and instructional strategies. Specific lessons were chosen to cover a range of phonetic elements, including consonant-vowel patterns, short and long vowel sounds, and common digraphs. Each selected lesson was closely examined for its use of multimedia components, such as visuals, audio, animations, and interactive prompts. This purposive sampling method allowed for an in-depth exploration of RB's instructional design, capturing the diversity of phonics content offered by the programme.

3.3 Data analysis

This study employed a qualitative content analysis method, with a directed approach, to evaluate RB in alignment with Mayer's 12 principles of multimedia learning (Hsieh & Shannon, 2005). This method started with a theory, i.e. Mayer's multimedia learning theories in this study as guidance and, the main strength of a directed approach to content analysis is that existing theory can be supported (Hsieh & Shannon, 2005). Further, open coding was adopted as the primary analytic method (Corbin & Strauss, 1990) and it allowed the researchers to break down the data into distinct units, labelling each multimedia element according to its function and alignment with Mayer's principles. For example, instances of spatial contiguity (placement of text and images close together) and coherence (removal of extraneous content) were coded according to Mayer's framework. This coding process enabled the identification of key themes, such as the use of visual cues, pacing of content, and adherence to the redundancy principle.

Following open coding, categories were refined through an iterative process, with similar codes grouped to form overarching themes. This analysis highlighted patterns in RB's instructional approach, revealing both strengths and limitations in relation to Mayer's multimedia learning principles.

4. Results

The qualitative content analysis of RB revealed distinct themes in its multimedia design and instructional approach, as well as areas where its alignment with Mayer's multimedia principles varied. By examining each principle individually, I identified key strengths and limitations in RB's design, as summarised below.

4.1 Coherence and signalling

One of the potential strengths in RB's design seems likely to be its alignment with the coherence principle, which suggests that extraneous content should be minimised to reduce cognitive overload. In the lessons reviewed, RB generally maintains a clear and focused presentation, avoiding unnecessary text, images, or sounds that might distract learners. This alignment seems particularly noticeable in lessons where phonetic elements are introduced with simple visuals and clear audio, which may enable learners to concentrate on phonetic rules without unrelated content.

However, this analysis also suggests areas where signalling, the use of cues to draw attention to essential material, could be more effectively implemented. While some lessons employed visual highlights or animated text to emphasise key sounds or letters, this approach was not consistent across all lessons. The inconsistent use of signalling might limit learners' ability to easily identify and focus on the critical aspects of each phonetic concept.

4.2 Spatial and temporal contiguity

RB gives the impression of showing adherence to the spatial contiguity principle, with related text and images generally presented close together on the screen. This layout may facilitate an intuitive connection between the visual representation of letters or words and their phonetic sounds, potentially supporting learners' understanding and retention. Temporal contiguity was also observed in most instances, with corresponding sounds and images occurring simultaneously, which might help reinforce phonetic associations through simultaneous visual and auditory input.

However, in some instances, minor delays between narration and visual changes were noted (such as the karaoke-style sentence reading), particularly in more complex lessons with multiple phonetic rules. Although these delays were brief, they could potentially disrupt cognitive processing for young learners. A more precise alignment of timing between visuals and sounds might improve the instructional flow and support learners' engagement.

4.3 Segmenting and pre-training

RB tends to segment content into manageable units, which may allow learners to engage with each phonetic rule individually before moving on to the next. This segmentation could be especially helpful for younger learners, who might struggle with sustained focus on multiple concepts. Each lesson seems to follow a structured format, with distinct sections for introduction, practice, and reinforcement, aligning with Mayer's segmenting principle and potentially making the learning process more accessible.

Pre-training, or the introduction of key concepts before presenting new content, was applied less consistently. While certain lessons included brief overviews of sounds or letters, others moved directly into examples without pre-training, especially in advanced phonics combinations involving more than two letters. This inconsistency might hinder learners who could benefit from initial familiarisation with phonetic concepts. A more structured pre-training phase might enhance RB's instructional effectiveness by better-preparing learners for new content.

4.4 Redundancy and modality

The redundancy principle advises against presenting identical information through multiple channels (e.g., audio and on-screen text) to avoid cognitive overload. In RB, there were instances where text was displayed while simultaneously narrating the same words. For young learners who may still be developing reading skills, this redundancy might be counterproductive, as it could potentially split their attention and reduce their focus on auditory instruction. Reducing on-screen text during narration could help RB align more closely with the redundancy principle, making the content easier for learners to process.

Regarding modality, RB seems to employ both visual and auditory channels effectively; however, as noted, the presence of redundant text may occasionally detract from this otherwise effective use of modality. Aligning more closely with the modality principle by using audio narration with images alone might further support young learners' comprehension.

4.5 Multimedia and personalisation

The multimedia principle, which suggests that combining words and pictures may enhance learning, suggests being effectively implemented in RB. By pairing visual representations of letters or words with audio narration, the programme seems to leverage both channels to reinforce phonetic concepts. This dual-channel approach could be effective in helping learners associate sounds with their written forms, an essential aspect of phonics instruction.

However, personalisation was identified as an area that might benefit from improvement. The programme currently uses a formal tone throughout, which may be less engaging for young children. According to Mayer's personalisation principle, a conversational style could potentially enhance learner engagement and make the material feel more accessible. Adjusting the tone to be more child-friendly and informal might help younger learners feel more connected to the content, possibly improving their engagement and retention.

4.6 Image principle and voice principle

The image principle suggests that including the speaker's image does not necessarily improve learning and may sometimes be a distraction. RB occasionally features the image of the speaker during lessons, which could potentially divert attention from the phonetic content. Removing these images in lessons where they may not contribute to comprehension might help maintain learners' focus on phonics instruction. However, this might be also understandable, as the speaker can demonstrate mouth movements for pronunciation.

The auditory element appears to be a key component of RB, with audio narration that seems clear enough to support students in understanding pronunciation. The auditory content is delivered in a human voice, which appears friendly and natural, aligning with Mayer's voice principle. Using a human voice, rather than a mechanised one, might enhance students' engagement and comprehension, potentially creating a learning experience that feels closer to natural interaction.

Additionally, the auditory sections of RB not only introduce pronunciation but also guide students in practising and repeating sounds. However, the pacing of the audio in some lessons seems somewhat fast, which may not be suitable for students who learn at a slower pace. It could be beneficial for the programme to include multiple playback speed options, allowing students to adjust the pace according to their individual learning needs.

5. Discussion

5.1 To what extent does RB adhere to Mayer's multimedia learning principles?

The analysis suggests that RB demonstrates substantial alignment with many of Mayer's multimedia principles, though there seem to be areas where adherence could be improved. Key principles such as spatial contiguity, segmenting, and multimedia integration seem to be effectively implemented, potentially supporting phonics learning by facilitating cognitive processing. The programme presents related text and visuals in proximity, and segments content into manageable units, which may make it easier for young learners to engage with phonics material one step at a time. The use of both auditory and visual channels, particularly in combining images with narration, suggests alignment with the multimedia and modality principles (Butcher, 2014; Low & Sweller, 2014), supporting dual-channel processing and making the learning experience more engaging and accessible for children. Additionally, the temporal contiguity principle is generally followed, with sounds and images presented simultaneously, which helps reinforce phonetic associations through coordinated sensory input.

However, there are specific principles which RB seems to show only partial adherence. For example, the redundancy principle advises against presenting identical information across multiple channels simultaneously; yet, RB often displays on-screen text alongside narration. This could potentially lead to cognitive overload for young learners, who might struggle to process text and audio simultaneously (Mayer, 2014a). Additionally, the personalisation principle, which recommends a conversational tone, is not fully realised, as the programme uses a formal tone throughout (Mayer, 2014c). Adjusting the language to a more child-friendly style might enhance relatability and engagement. Furthermore, signalling could be applied more consistently across lessons to direct learners' attention to key sounds and letters, enhancing their focus on critical phonetic concepts. While the auditory component generally seems effective, the pace of audio delivery in some lessons might benefit from refinement to accommodate varying learning speeds, allowing learners to adjust to a slower pace if needed.

5.2 How effective is the design of RB in supporting phonics learning according to these principles?

Overall, RB's design appears effective in supporting phonics learning, as it seems to leverage several core multimedia principles that are believed to enhance cognitive processing and retention. The programme's alignment with spatial contiguity, segmenting, and multimedia principles seems to create a foundation for phonics instruction by helping learners make connections between letters, sounds, and words. By presenting content in manageable segments, RB allows learners to focus on specific phonetic rules without overwhelming them, which could be particularly beneficial for young children with limited attention spans.

Additionally, RB generally follows the temporal contiguity principle by presenting sounds and visuals simultaneously, which reinforces phonetic associations through coordinated sensory input. However, minor delays between narration and visuals were observed in more complex lessons, which might slightly disrupt the learning flow for young children.

The use of a clear, friendly human voice in the auditory elements adds an engaging layer to the learning experience, which appears to align well with the voice principle (Mayer, 2014c) and may promote a more natural interaction. This

approach seems effective in guiding students through pronunciation and encouraging practice, both of which are essential in phonics learning. However, refining the audio pacing, offering multiple playback speed options, and adopting a more child-friendly style could potentially enhance accessibility, making the content more adaptable to individual learning needs.

Furthermore, RB could improve its consistency with the signalling principle. While some lessons use visual cues, such as highlighting and animations, to emphasise key phonetic elements, a more consistent application of these signals across all lessons might better help learners identify and focus on critical content.

While RB appears effective in many respects, certain improvements might further optimise its design for phonics instruction. Reducing redundant text, adopting a conversational tone, and removing the speaker's image where it may not add instructional value could better align the programme with Mayer's principles. Additionally, aligning more closely with the personalisation principle, such as offering learners options to adjust content based on their individual needs, could make the experience more interactive and engaging.

These adjustments could help minimise cognitive load while fostering a more engaging, learner-centred experience (Mayer, 2014a). Overall, while RB seems to support phonics learning effectively through its application of multimedia principles, targeted refinements might further enhance its educational impact and usability for early learners.

5.3 Limitations and recommendations

This study has certain limitations that should be considered when interpreting the findings. First, the analysis was conducted by a single researcher, which may introduce some degree of subjective bias in evaluating RB based on Mayer's multimedia learning principles. Although efforts were made to maintain objectivity, the results may reflect individual interpretations of the programme's adherence to these principles.

Additionally, this study is small-scale and qualitative in nature, focusing on a relatively in-depth examination of specific lessons within RB rather than a comprehensive, large-scale analysis. As such, the findings might be limited in their validity. Due to its nature, the study could not capture how diverse groups of learners' experience and respond to the programme in different educational settings.

Given these limitations, further research could consider building upon this initial analysis. A larger-scale study involving multiple researchers and a broader range of lessons from RB could provide a more comprehensive view of the programme's effectiveness. For instance, inviting language teachers or experts to conduct an evaluative study using a standardised rating scale based on Mayer's principles could allow for a more objective quantitative assessment of RB. Such a scale would enable experts to score the programme, enhancing the rigour and reliability of the findings.

Additionally, incorporating feedback from diverse user groups, such as students and teachers across various educational contexts could offer valuable insights into the programme's practical application and efficacy. This approach would help assess RB's impact in real-world educational settings and support the development of optimised classroom practices.

Comparative studies involving multiple phonics programmes would also be beneficial. By examining how different programmes align with Mayer's principles and impact phonics learning, future research could provide a clearer understanding of the strengths and limitations of multimedia tools in early literacy instruction. Such research would contribute to the development of optimised practices for implementing and even developing multimedia phonics resources that are accessible and effective for young learners.

6. Conclusion

This study evaluated RB, a multimedia phonics learning programme, using Mayer's 12 principles of multimedia learning to assess its instructional design and effectiveness in supporting early literacy. The findings suggest that RB relatively aligns well with several key multimedia principles, notably spatial contiguity (Mayer & Fiorella, 2014), segmenting (Mayer & Pilegard, 2014), multimedia integration (Butcher, 2014) and modality (Low & Sweller, 2014). These principles are critical in phonics instruction, helping learners associate sounds with letters and words through a well-structured and engaging format. By presenting content in manageable segments and combining visuals with narration, RB effectively leverages dual-channel processing, making it potentially a resource for young learners.

However, the evaluation also revealed limitations in RB that might reduce its educational impact. For instance, the programme's use of on-screen text alongside narration might not fully adhere to the redundancy principle, which could

lead to cognitive overload for beginning readers (Kalyuga & Sweller, 2014; Mayer, 2014a). Additionally, incorporating a more conversational tone and adjusting audio pacing could improve the programme's alignment with the personalisation (Mayer, 2014c) and modality principles (Low & Sweller, 2014), making the learning experience more engaging and accessible for learners with varying learning speeds.

Overall, RB offers a relatively solid foundation for phonics learning through its thoughtful alignment with multimedia principles. There might be no doubt that it is the pedagogy that determines the educational value of technology, otherwise it risks becoming merely a fancy tool (Børte & Lillejord, 2024; Lan, 2021). By integrating robust pedagogical approaches, RB could be likely to serve as an effective educational tool, fostering phonics acquisition in a more accessible, learner-centred manner. The insights from this analysis are intended to support schools, educational administrators, teachers and policymakers in selecting engaging, research-based phonics resources tailored to diverse learning needs when considering the implementation of phonics programmes in various learning contexts.

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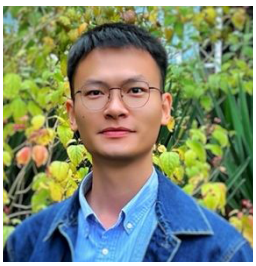

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Appendix A: Multimedia learning principles checklist for Reading Bear

No.	Principle	Evaluation Criteria
1	Coherence Principle	Does *Reading Bear* avoid including unnecessary words, images, or voices to reduce cognitive load?
2	Signalling Principle	Are there visual or auditory cues to highlight the organisation of essential content?
3	Redundancy Principle	Does *Reading Bear* avoid presenting on-screen text alongside graphics and narration to prevent cognitive overload?
4	Spatial Contiguity Principle	Are related words and images positioned near each other on the screen to help learners make connections?
5	Temporal Contiguity Principle	Are words and corresponding images or animations presented simultaneously rather than sequentially?
6	Segmenting Principle	Is content divided into user-paced segments to allow learners to process each part before moving to the next?
7	Pre-training Principle	Are key concepts or vocabulary introduced before presenting new, complex content?
8	Modality Principle	Does *Reading Bear* use graphics and narration rather than on-screen text with animations to support learning?
9	Multimedia Principle	Does *Reading Bear* combine words and pictures rather than using words alone to enhance understanding?
10	Personalisation Principle	Is the language in a conversational style rather than formal to make learning more engaging?
11	Voice Principle	Is the narration spoken in a friendly, human voice rather than a mechanical or robotic tone?
12	Image Principle	Does *Reading Bear* avoid adding the speaker's image on the screen unless it is necessary for learning?