

How ARpedia supports early readers

ARpedia



1. Background and Objectives

- Securing credible data to support ARpedia
- Establishing a position as an evidence-based product for marketing purposes
- Understanding how learning occurs to derive long-term product improvement strategies
- Gathering feedback from education stakeholders in the United States

2. Research Period

- May 2023 to February 2024 (approximately 10 months)

3. Research Performers

- by Professor and researchers from [Teachers College, Columbia University](#), including:
 - Yoo Kyung Chang
 - Jordan Burkland
 - Julia Lim

AR-enhanced books have been explored to support literacy development, but with limited understanding of when and how specific AR design may be supportive.

Therefore, this study investigates:

- 1) How early readers interact with AR-based books.
- 2) The literacy behaviors that emerge based on ARpedia's augmented reality design principles.
- 3) how early readers with different characteristics manifested literacy behavior during and after reading with ARpedia.

Rubric of Literacy Behavior

Literacy behavior was coded by analyzing video recorded children’s behavior including their behavioral engagement, gestures, articulation and more, using the rubric of literacy behavior.

print concept	phonemic awareness	vocabulary	motivation	interest
				value
				self-efficacy
phonics	fluency	comprehension	engagement	attentional control
				depth of engagement
				duration and repetition

Participants	Children aged six to eight, enrolled in first, second, and third grades
Procedure	1) Children were first asked a series of questions regarding their reading motivation and habits.
	2) Then, children were invited to pick one book.
	3) Children were asked to read the print-only book for up to 15 minutes.
	4) Children were then asked to continue reading with the AR application, for up to 20 minutes.

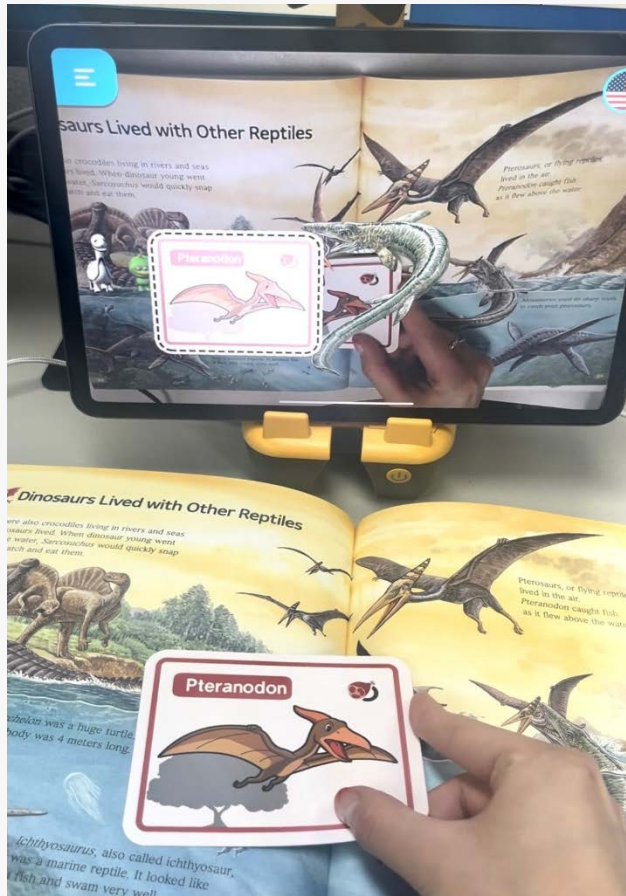
*The entire procedure was video recorded and the AR-application was captured through screen capture video.

Extracted from literature on empirical studies investigating the effectiveness of augmented reality for learning purposes, and defined using cases extracted from ARpedia.

Reducing Cognitive Load	Enhancing Multi-modal Engagement	Increasing Personalization	Increasing Positive Affect in Learning
AR Annotation	Multimodal Synchronicity	Age- Appropriate Interactivity	Narrative Learning
Non-distractive Design	Embodied Interaction Facilitation	Explorative Learning	Gameful Learning
Attentional Guidance		User-Created Asset	Fantastical-Real Balance
Conceptual Visualization			Anthropomorphic Balance

Reducing Cognitive Load – Non-Distractive Design

Ensure AR elements avoid distractions, obscurities, or the inclusion of additional information not crucial to the educational content, as that can hinder learning in AR.



Example of non-distractive design used in ARpedia:

- users are guided to use a Pteranodon marker to help a virtual dinosaur character to cross water.
- This design led readers to focus solely on this task without unrelated animations or effects, ensuring AR elements support the educational goal without introducing distractions.

Reducing Cognitive Load – Attentional Guidance

Minimize cognitive load by incorporating the signaling principle and utilizing 3D representations to direct learners' focus.

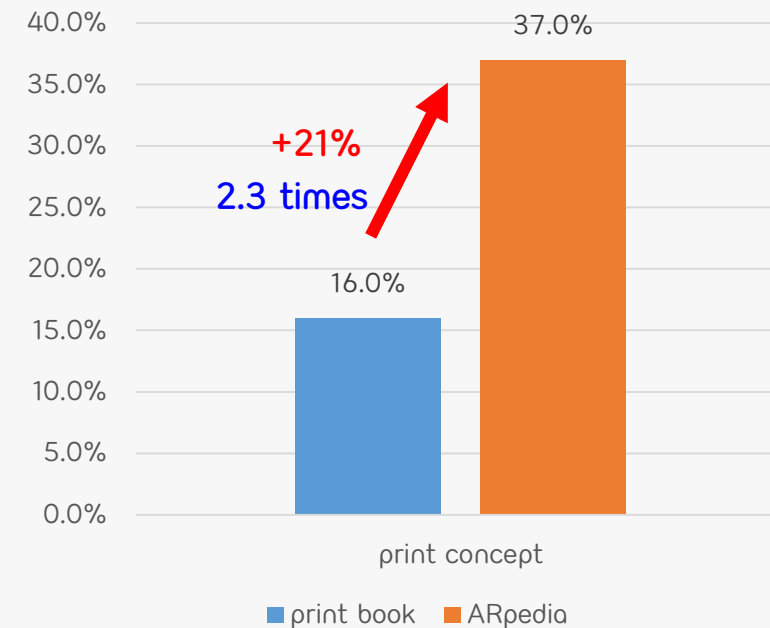


Example of attentional guidance design used in ARpedia:

- the use of visual cues to direct the user's focus towards interactive elements or tasks.
- for example, readers were often directed which dinosaur marker to use next through a blinking visual of the dinosaur on the tablet screen.

When attentional guidance design was integrated into ARpedia,

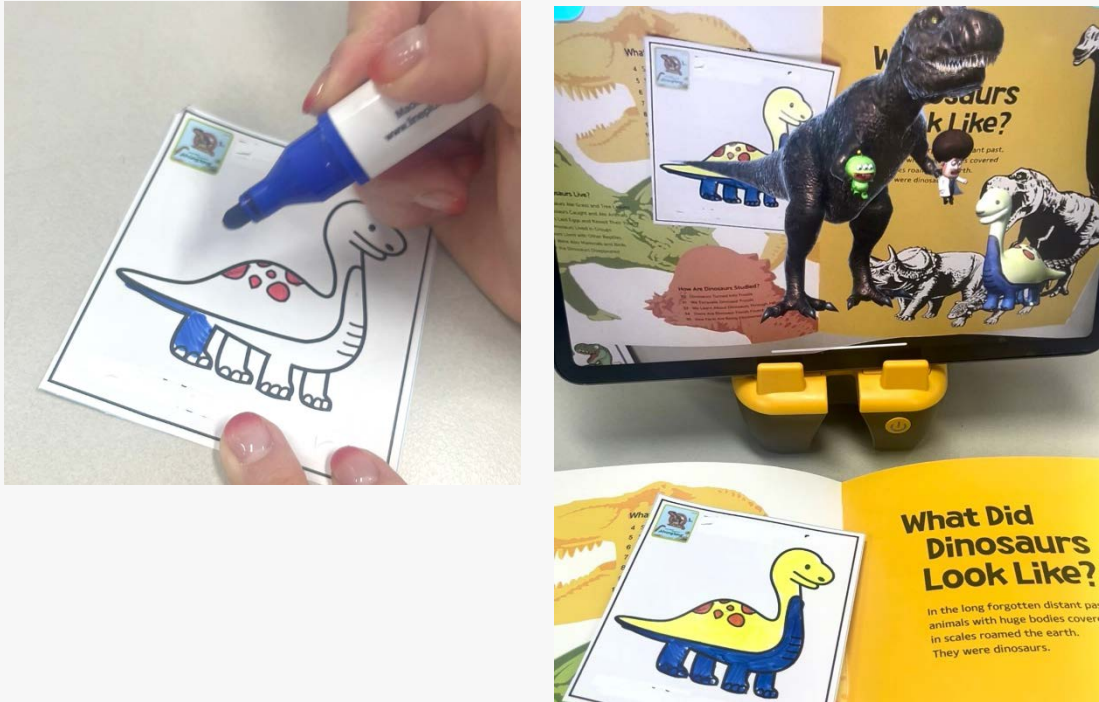
- Observation of print concept behavior increased by **21%**, **2.3 times**.



*Print concept: knowledge and ability to recognize and interact with basic features of medium, including print and multimodal representations.

Increasing Personalization – Age-Appropriate Interactivity

Offer interaction mechanisms suitable for the learner's developmental stage to enhance usability and learning experiences.

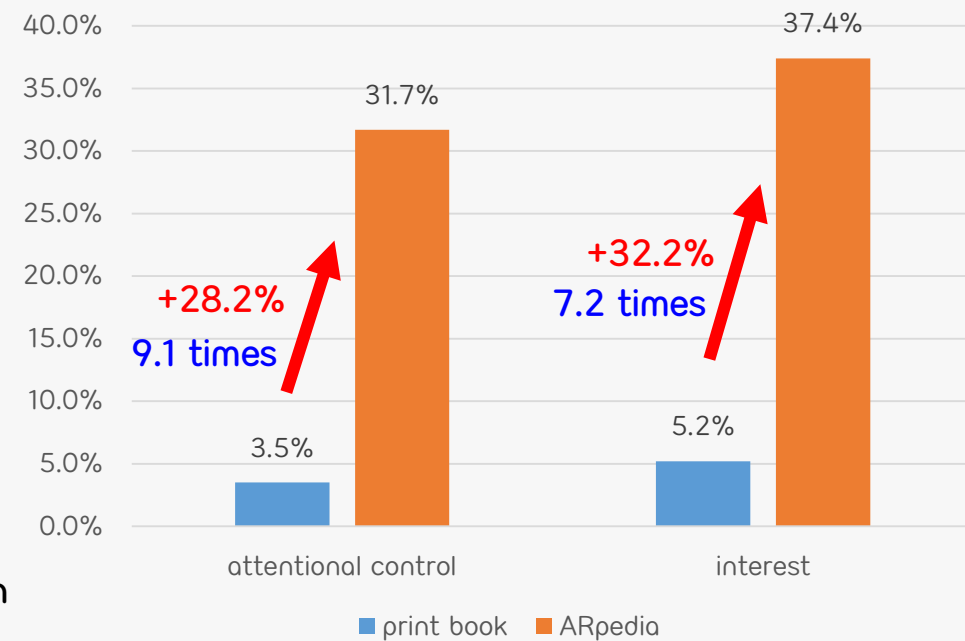


Example of age-appropriate interactivity design used in ARpedia:

- activities such as coloring and scanning dinosaur markers, exemplified age-appropriate interactivity by matching the complexity of interaction to the cognitive and motor skills of the target age group.

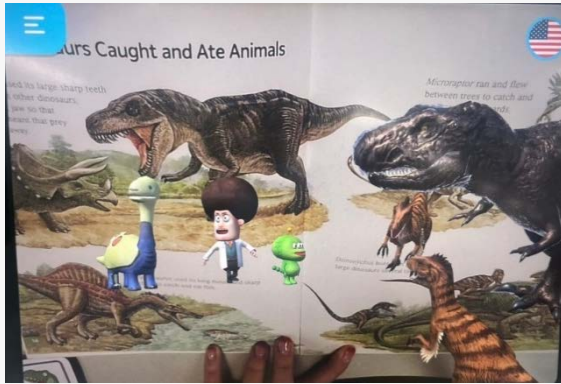
When age-appropriate interactivity design was integrated into ARpedia,

- Observation of attentional control increased by **28.2%**, **9.1 times**,
- interest behavior increased by **32.2%**, **7.2 times**.



Increasing Positive Affect in Learning – Narrative Learning

Enhance comprehension and retention by integrating educational content within engaging storylines, making AR experiences and locations meaningful and relevant.

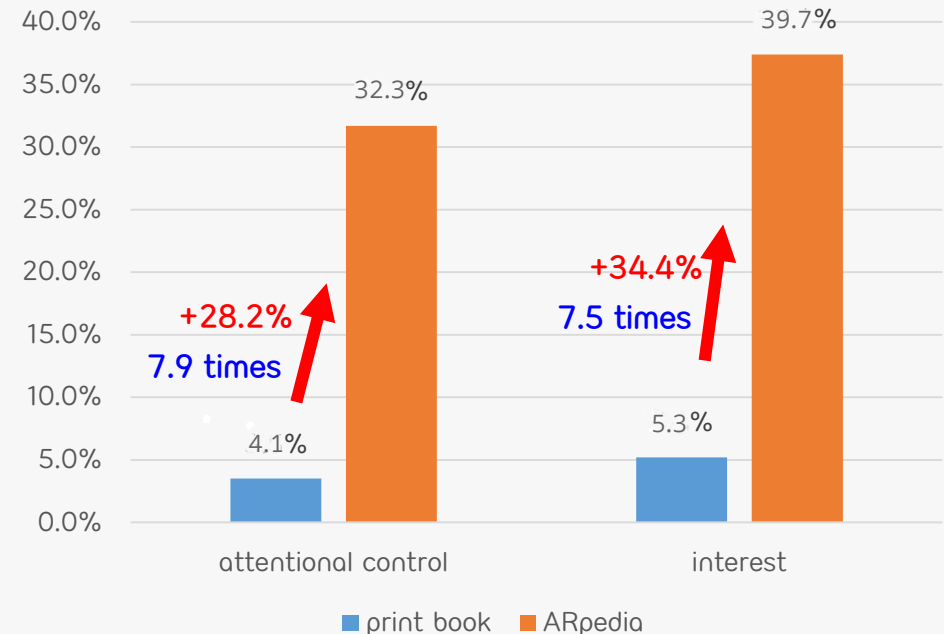


Example of Narrative Learning design used in ARpedia:

- embedding facts within distinct storylines of time traveling to the age of dinosaurs or role-playing as a weather school student adventuring around the world, connecting educational content to creative narratives.

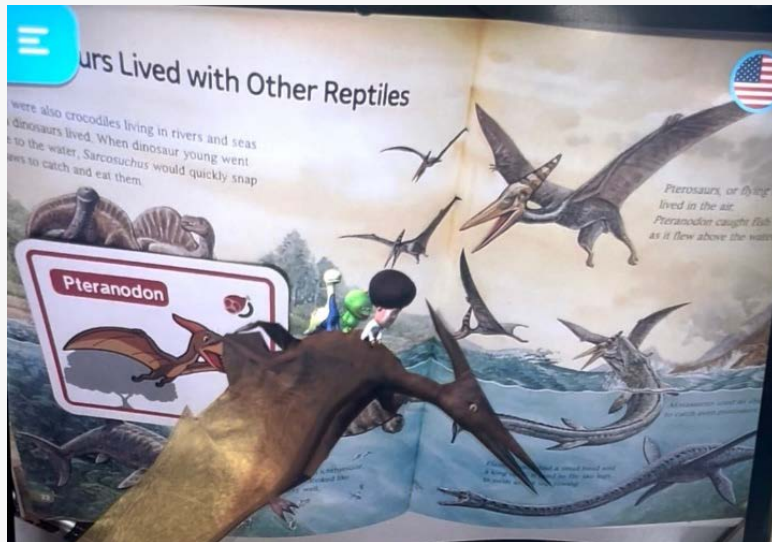
When narrative learning design was integrated into ARpedia,

- Observation of attentional control increased by **28.2%**, **7.9 times**,
- interest behavior increased by **34.4%**, **7.5 times**.



Increasing Positive Affect in Learning – Fantastical-Real Balance

Balance engaging fantastical elements with the real-world applicability of content, ensuring that the fantasy does not hinder understanding, by ensuring fantastical elements are accompanied with clear and applicable information.

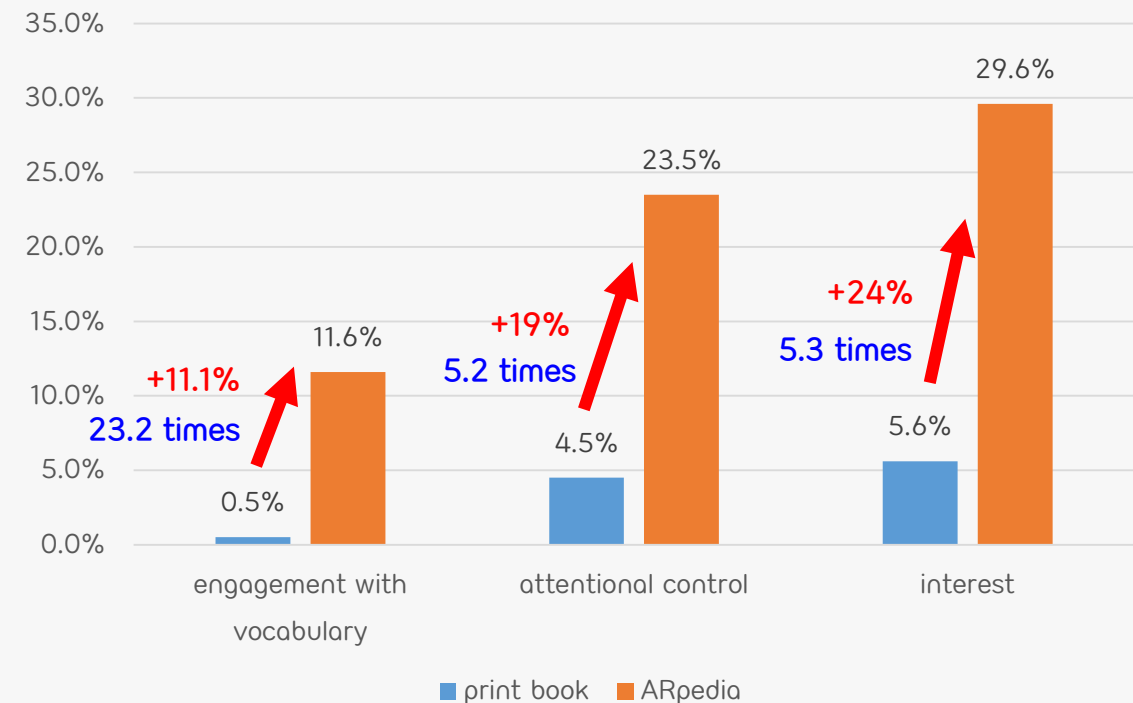


Example of fantastical-real balance design used in ARpedia:

- using a virtual pteranodon for narrative transportation while embedding real dinosaur facts about its ability to fly exemplifies fantastical-real balance, blending accurate information about the creatures biology with fantastical elements of adventuring with dinosaurs.

When fantastical-real balance design was integrated into ARpedia,

- Engagement with vocabulary increased by **11.1%**, **23.2 times**,
- attentional control increased by **19%**, **5.2 times**,
- interest behavior increased by **24%**, **5.3 times**.



Increasing Positive Affect in Learning – Anthropomorphic Balance

Balance the use of anthropomorphic elements with the necessity for easy recognition of applicable information, maintaining engagement without compromising learning.

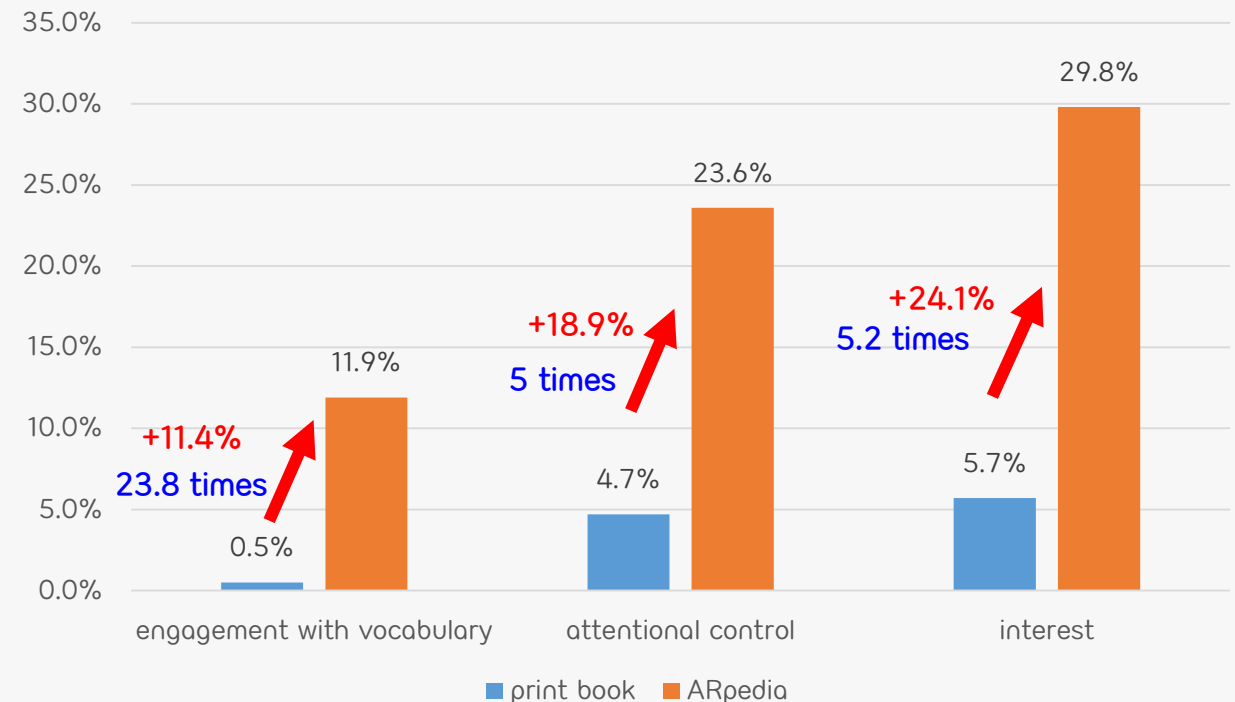


Example of anthropomorphic balance design used in ARpedia:

- dinosaurs discuss their features in a human-like manner while conveying accurate scientific information.

When anthropomorphic balance design was integrated into ARpedia,

- Engagement with vocabulary increased by **11.4%**, **23.8 times**,
- attentional control increased by **18.9%**, **5 times**,
- interest behavior increased by **24.1%**, **5.2 times**.



1) Average Observations of Attentional Control Behavior

– Increased by **28.9%**, **6.7 times**, when ARpedia AR designs(below) are applied:

- Non-distractive
- Age-Appropriate Interactivity
- Narrative Learning
- Fantastical-Real Balance

2) Average Observations of Print Concept Behavior

– increased by **21%**, **2.3 times**, when ARpedia AR designs(below) are applied:

- Attentional Guidance

3) Average Observations of Interest Behavior

– Increased by **28.8%**, **6.1 times**, when ARpedia AR designs(below) are applied:

- Non-distractive
- Age-Appropriate Interactivity
- Narrative Learning
- Fantastical-Real Balance
- Anthropomorphic Balance

4) Average Observations of Engagement with Vocabulary

– increased by **11.3%**, **23.5 times**, when ARpedia AR designs(below) are applied:

- Fantastical-Real Balance
- Anthropomorphic Balance

Thank you