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Exploring the Creative Methods of Comic Language in Augmented Reality Children's Book

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Abstract

The integration of augmented reality (AR) into children's literature has transformed traditional reading experiences, creating immersive and interactive environments that engage young readers. This study examines the creative methods of comic language within AR children's books, positing that the combination of humor and visual storytelling can significantly enhance children's reading interest and comprehension. Building on the premise that playful and memorable experiences are crucial for fostering a love of reading—especially among those who may struggle with lengthy texts (Dunleavy & Dede, 2014). This empirical research aims to fill the existing gap in the literature regarding comic language in AR contexts. The investigation focuses on two key dimensions: (1) the visual semantics and narrative techniques employed in the selected comic languages that are integrated into AR storytelling, and (2) a comparative analysis of the benefits and limitations of comic-based animated AR storytelling versus traditional AR books and paper- based formats. The findings are expected to provide insights into the design methods and effectiveness of comic language as a pedagogical tool in augmented reality books, offering implications for educators, authors, and developers in the field of children's literature.

Introduction

The integration of storytelling techniques from diverse media forms—such as film, theater, and comics—into augmented reality (AR) technology remains unexplored. To fully leverage the transformative potential of AR in educational contexts, it is crucial to adopt a multidisciplinary approach that synthesizes storytelling methods and comic language, thereby creating immersive and engaging learning experiences. This empirical study aims to investigate the creative methods of comic storytelling and animation in AR children's storybooks, with a focus on how these elements can enhance children's comprehension and engagement.

Comic language, characterized by its use of humor, playful expressions, and exaggerated visuals, often incorporates cinematic techniques such as zooming, camera angles, and dynamic scene design. By integrating comic language into AR books, we can capture children's attention and make the learning experience more enjoyable. As Tiemensma (2009) claimed, "Comics can provide a stepping stone to other kinds of reading and their acceptance as part of reading materials especially at school can support children who are reluctant to read for pleasure. 'Comics are books, too'."

While the benefits of AR in children's education are well-documented, the specific role of comic language in amplifying these advantages warrants further exploration and experimentation.

The literature review will explore the impact of comic language and AR on stimulating children's interest in reading and improving comprehension. Primary school children, who

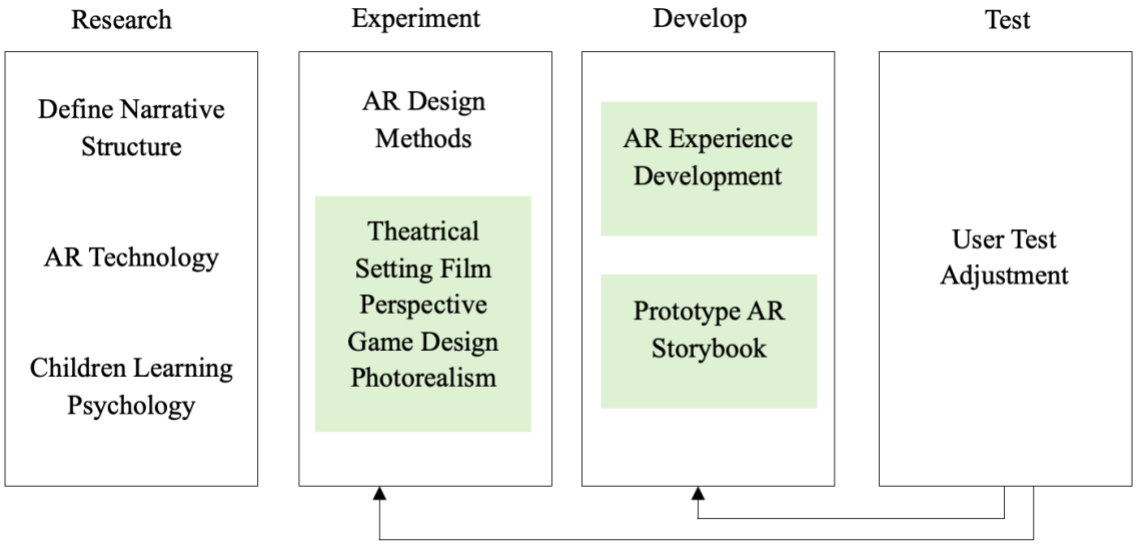
typically possess a more limited vocabulary than adults, may struggle with understanding text-based books. The fusion of humor and visual storytelling found in comics serves as a powerful tool to alleviate the anxiety often associated with reading (Frey et al., 2008).

This study seeks to examine the effectiveness of combining AR technology with comic storytelling, presenting a unique opportunity to engage young readers. The empirical research process is grounded in theoretical frameworks based on Visual Rhetoric Theory (Figure 1) and comic language. Utilizing a Design-Based Research (DBR) methodology, the study will explore how visual elements and metaphors can effectively communicate and persuade. In the design process of the AR storybook "The House of Elf," visual rhetoric will be employed to create engaging metaphors and comedic elements that resonate with children.

Inspired by Multimodal Theory, developed by Gunther Kress and Theo van Leeuwen (2001), which emphasizes the significance of multiple modes of communication (e.g., animation, images, audio) in conveying meaning, the project will compare three distinct formats: (1) Mode A: a graphical book without AR; (2) Mode B: a graphical book with simple AR animation (featuring animated objects or characters without comic language); and (3) Mode C: a graphical book with AR animation that incorporates comic language (utilizing camera perspectives, dialogue bubbles, theatrical elements, and visual syntax). This survey and design of 'The House of Elf' aims to investigate the potential of integrating the visual communication language of comics into augmented reality (AR) children's books to enhance storytelling and increase children's interest in reading.

Figure 1

Research Framework for AR Storybook 'The Evil House Elf' inspired by Visual Rhetoric Theory and Multimodal Theory



To deepen the understanding of the impact of comical language on children's reading comprehension, three formats of storybooks have been designed with two main phases of research questionnaires conducted among two groups of elementary school children, respectively 4th- and 5th-grade students.

The research questions are:

1. How do children perceive and interact with comic language in AR formats compared to traditional paper-based children's literature?
2. What are the cognitive benefits and challenges faced by children when engaging with comic-based animated AR storytelling versus traditional AR books?
3. What specific visual semantics and narrative techniques are most effective in enhancing comprehension and retention in AR storytelling for children?
4. What specific comical semantics and narrative techniques are effective in enhancing comprehension and retention in AR storytelling for children?

The proposed research on integrating comic storytelling techniques with augmented reality (AR) in children's storybooks holds significant potential benefits for various stakeholders, including children, educators, and AR book developers/designers. It can further give insights into how children interact with AR formats can help designers create more intuitive and engaging applications that reflect user preferences and cognitive engagement patterns. The design methods of "The Evil House Elf" may provide creative strategies for comic-based animated AR book design for educators or children's book content developer.

Literature Review

Prior studies conducted by educators Mohamad and Husnin (2023) have demonstrated that the integration of augmented reality in educational materials for children can significantly improve their engagement and learning outcomes. Specifically, studies have shown that AR-enhanced children's books can increase proficiency in reading and comprehending the content. For instance, a study by Cieza and Lujan (2018) found that integrating AR into flashcards for kindergarten children resulted in a 22.6% increase in their level of number reading proficiency and a 27.6% increase in their level of vocal reading proficiency. Furthermore, AR flashcards suggest that the dynamic and interactive nature of AR environments can inspire a love of learning and enhance children's cognitive abilities, such as memory, comprehension, and application of the material. A study by Schwarz (2015) investigated the effects of comic language on reading motivation and comprehension in elementary school students, the research indicated that 78% of students reported higher motivation to read when exposed to comic language. Comprehension assessments showed a 15% increase in understanding narratives presented in comic formats compared to traditional texts.

The Role of Comic Language in Children's Literature

Comic language, characterized by its use of humor, visual storytelling techniques, and informal dialogue, has been shown to captivate young audiences. Studies suggest that comic books and graphic novels can serve as effective tools for literacy development (Frey et al., 2008; Jones, 2010; Williams, 2008). The visual elements inherent in comics can aid in comprehension, as they provide contextual clues that assist readers in understanding the narrative (Cohn, 2020). Furthermore, the humor often found in comic language can make reading a more enjoyable experience, encouraging reluctant readers to engage with texts (Fisher & Lapp, 2011).

Augmented Reality in Children's Reading

Augmented reality has emerged as a transformative technology in education, offering interactive experiences that enhance traditional reading (Dunleavy & Dede, 2014; Richardson, 2016). AR applications can overlay digital content onto physical books, allowing children to interact with characters and narratives in ways that were previously unimaginable. Research indicates that AR can increase motivation and engagement in reading, as it provides a multisensory experience that appeals to diverse learning styles (Abate & Nappi, 2016; Tsai, 2020). The combination of AR and comic language can further amplify these effects, creating a dynamic reading environment that captivates young readers.

Enhancing Reading Interest

Several studies have highlighted the positive impact of comic language and AR on children's reading interests. For instance, Billinghurst and Duenser (2012); Shaaban and Mohamed (2024) found that AR applications that incorporate humor and visual storytelling can lower the anxiety associated with reading, particularly for struggling readers. By making reading more accessible and enjoyable, these tools can foster a love for literature among children. Additionally, Orekoya, Chan, and Chik (2014) noted that the playful nature of comic language can motivate children to read more frequently, as they are drawn to engaging visuals and humorous narratives.

Improving Comprehension

The effectiveness of comic language and AR in enhancing reading comprehension has also been supported by empirical research. The visual cues provided by comics can help young readers make connections between text and illustrations, improving their understanding of the story (Frey et al., 2008). Furthermore, AR can facilitate interactive learning experiences that reinforce comprehension skills. For example, when children can see characters come to life through AR, they are more likely to engage with the material on a deeper level (Dunleavy & Dede, 2014). Studies have shown that children who interact with AR-enhanced texts demonstrate improved comprehension scores compared to those who read traditional texts alone (Tsai, 2020).

Methodologies

This study employs a Design-Based Research (DBR) framework, emphasizing an iterative, collaborative approach to investigate the application of comic language in AR storytelling in comparison to conventional 2D illustration pages and further investigate students' comprehension levels on three major formats. The illustrated book "The Evil House Elf" is designed in three different formats for the target readers from elementary school. Our research team developed a case study and gave questionnaires from the book "The House Evil Elf" to 4th-grade class of 37 students (N=37) and 5th-grade of 32 students (N=32) in Ren-Ai primary school in Taipei City. The survey consists of two phases: (1) children's preference of media format; (2) students' comprehension levels across three formats.

The Use of Comic Language in the AR Book Design "The Evil House Elf" for Experiments

The influence of film language on comic storytelling is a notable area of scholarly interest, highlighting the interplay between visual media and narrative techniques. According to (McCloud, 1993), "Comics are a medium that can combine the visual storytelling techniques of

film with the unique sequential art of graphic narratives," suggesting that both forms share fundamental elements such as framing, pacing, and visual composition. "The Evil House Elf" is a narrative-driven augmented reality project co-designed with my students for a module assignment by my supervised student Chan Nga Kei that delves into the concept of storytelling through a graphical book format. The protagonist, a mischievous House Elf, welcomes the audience with a personalized introduction: "Hi, I am a house elf, always trying to ruin and help every family!" Embodied as a playful young boy, the Elf seeks attention and affection by subtly disrupting the household routine, creating a sense of engagement and whimsy. This project is deliberately crafted as an object-based graphical book, featuring four distinct sets, each offering a unique approach to humorous storytelling.

Design Method of Scene One: Theatrical Setting

Design Concept and Method: In the opening of the book, each page is designed to "stand up" from the storybook when flipped, creating a distinctive area for the AR app to anchor on. In this set, the animated protagonist acts as an actor on stage, interacting with the audience. By incorporating theatrical and sound elements, such as stage direction and audience interaction, readers are immersed in the story as if they are watching a live performance. This approach enhances engagement and encourages imaginative play, making the reading experience more interactive and dynamic. In this interactive scene, the animation is triggered by the physical action of page flipping, creating a seamless blend of physical and digital environments. The background music plays continuously throughout the narrative, providing an immersive sonic experience. The story is structured into four distinct scenes, each featuring AR pop-up animations that incorporate dialogue boxes to convey the mischievous personality of the elf protagonist. The narrative begins with the elf taking center stage, engaging with the audience through an interactive dialogue that asks, "Do you want to play some tricks together?" (Figure 2). The user's interaction is simulated through animated button clicks, creating a sense of real-time engagement. The AR story is characterized by noticeable hand-held camera movements, which contribute to a natural and hybrid experience.

Figure 2

Scene 1: The Preformulated Interaction at The Opening Theatre Scene in 'The Evil House Elf'

Design Approach of Scene Two: Film Language and Point of View

One of the comic languages is camera perspectives used to mimic the protagonist's experience inside his closet from the director's point of view (POV). By adopting film language

techniques, such as camera angles and editing, readers are transported into the protagonist's world, experiencing the story from a new and dynamic perspective (Figure 3). This approach adds a visual and dynamic element to the narrative, creating a more immersive and engaging reading experience. To trigger the audience's curiosity, the Elf protagonist steals a pair of socks in the closet for fun. This subtle action is captured by the camera, which is positioned in a close-up shot, giving the impression that it is filming from the protagonist's point of view. However, upon closer examination, it becomes clear that the camera is situated in the director's point of view, creating a sense of omniscience and further blurring the boundaries between the physical and digital worlds.

Figure 3

The Elf Stealing Socks From a Closet, Is Animated AR From The Director's Point Of View

Design Approach of Scene Three: Visual Language of Comics with Pop-ups in Layers

In this set, dialogues are presented in the form of bubbles with pop-ups, replacing the missing audio signals. By using pop-up buddle-like dialogue boxes, sound, texts, and expressions can be conveyed in storytelling through a playful tone (Figure 4 and Figure 5). The pop-ups are displayed in 3-dimensional layers to create dynamics. In the subsequent scene, set in a bedroom, the AR pop-up images are rendered in a "cut-out" style, with layers of visual elements and a dialogue box providing sound effects above. This deliberate layering technique enhances the depth of field by creating a sense of dimensionality. Similarly, the set design employs this method of overlapping layers in subsequent scenes, leveraging AR technology to create a rich and immersive visual experience. This approach enhances the humor and playful nature of the narrative, making the reading experience more enjoyable and engaging for young readers. Stories in comics attract students' attention. Comics can not only explain abstract science concepts, but can also provide humor, contextualize learning, and visualize objects. AR incorporated with comical semantics has the potential to attract children to read and interact in a more immersive and entertaining way.

Figure 4 & Figure 5

Comical Semantics Such as Pop-Up Bubbles Turn to A "Cut Out" Style In Layers Depicting Sound and Expressing Emotions

Design Approach of Scene Four: Game-like Animation

As the elf protagonist engages with ghostly entities in his sister's bedroom under the cover of night, the first spectral opponent is vanquished and subsequently disappears, only to be replaced by a new apparition. The AR animation is designed to simulate game-like interactions, thereby tapping into children's innate affinity for heroic gaming (Figure 6). By incorporating game-like animation in children's book AR, the medium can foster a more immersive and participatory experience for young readers, while also providing opportunities for cognitive development and character education.

Figure 6. Game-like Animation in Scene 4, fighting with ghosts in the bedroom.

Design Approach of Scene Five (Ending): Photorealism and Animation

In this narrative, the elf is a young boy back in real life, and is depicted as cuddling with his grandmother, as if he is lost in a daydreaming. The main feature of the visual design is the integration of photorealism and animation elements, which creates an authentic and immersive reading experience. This technique suggests that the elf's fantastical journey is merely a product of the boy's imagination, as he daydreams in his grandmother's arms, now he is back to reality. By combining realistic visuals with animated elements, readers are transported into a vivid and

dynamic world that enhances their sense of realism, familiarity, and engagement with the story (Figure 7). This approach adds a layer of depth and comprehension to the narrative, making the reading experience more immersive and captivating for children reader.

Figure 7

This Set Integrates Photorealism and Animation Characteristics to Create An Everydayness and Immersive Reading Experience

The Process of User Testing

As previously mentioned, this empirical study further examines the effectiveness of integrating comic language into augmented reality (AR) children's books to enhance children's engagement and comprehension. The study compares three formats of books, which are as follows:

Type A: Graphical books without AR

Type B: Graphic books featuring simple AR animations (such as animated objects or characters moving their hands, but without comic language)

Type C: Graphic books incorporating AR animations alongside comic language (utilizing cinematic perspectives, dialogue bubbles, visual syntax, etc.)

First Phase of the Study: Children's Preference of Media Format

The first experiment is to test children' preference for media format among the three types of storytelling above. The first part of the study aims to understand which media format will attract children the most. Children in the 4th-grade class can freely choose the format type of storybook 'The House Evil Elf' in which there are three types of storybooks were presented briefly to 37 students (N=37), there are three students chose paper-based books (Type A), 10 students chose AR book (Type B) and 14 chose comical AR book (Type C) (Figure 8).

Figure 8

Fourth-Grade Class Students' Preference for Media Type

Book Type	Media Format	Participants	Percentage %
Type A	Graphical book without AR	3	8.1

Type B	Graphic Book with simple AR animation	10	27
Type C	Graphic Book with AR animation incorporated with comic language	14	37

Results in the 5th-grade class of 32 students (N=32), there are two students chose paper-based books (Type A), seven students chose AR book (Type B) and 13 chose comical AR book (Type C) (Figure 9).

Figure 9

Fifth-Grade Class Students' Preference for Media Type

Book Type	Media Format	Participants	Percentage %
Type A	Graphical book without AR	2	6.2
Type B	Graphic Book with simple AR animation	7	21.8
Type C	Graphic Book with AR animation incorporated with comic language	13	40.6

Second Phase of the Study: Analysis of Students' Comprehension Levels Across Three Formats

The second phase of this study investigates students' comprehension levels concerning three different formats. Participants were divided into three groups according to these formats: Group 1 engaged with Format A, Group 2 with Format B, and Group 3 with Format C. Following the reading session, the teacher invited the students to complete questionnaires designed to assess their comprehension, memory, and engagement levels.

The questionnaire consisted of five questions, each measured on a scale from 1 to 5, with 1 indicating strong disagreement and 5 indicating strong agreement:

1. How clear did you find the story? (Scale: 1 to 5)
2. Did you find the story interesting? (Scale: 1 to 5)
3. Which rooms did Little Elf not visit? (Options: 4.1 Stage; 4.2 Bedroom; 4.3 Kitchen; 4.4 Balcony)
4. Who else did Little Elf encounter? (Options: 5.1 Elf's brother; 5.2 Grandmother; 5.3 Ghosts; 5.4 Sisters)
5. What scene of the story did you find most appealing and why? (total of five scenes)

Result of Experiments

Results for Fourth-Grade Students:

Q1. How clear did you find the story? (Scale: 1 to 5)

- Average score for Group A: 3.2

- Average score for Group B: 4.4
- Average score for Group C: 4.8

Q2. Did you find the story interesting? (Scale: 1 to 5)

- Average score for Group A: 3.1
- Average score for Group B: 4.2
- Average score for Group C: 4.5

Results for Fifth-Grade Students:

Q1. How clear did you find the story? (Scale: 1 to 5)

- Average score for Group A: 3.8
- Average score for Group B: 4.6
- Average score for Group C: 4.9

Q2. Did you find the story interesting? (Scale: 1 to 5)

- Average score for Group A: 3.5
- Average score for Group B: 4.5
- Average score for Group C: 4.8

Results for Fourth-Grade Students in Q4:

Which rooms did Little Elf not visit? (Options: 4.1 Stage; 4.2 Bedroom; 4.3 Kitchen; 4.4 Balcony)

- 72 percent correct for Group A
- 84 percent correct for Group B
- 90 percent correct for Group C

Results for Fourth-Grade Students in Q5:

- 77 percent correct for Group A
- 88 percent correct for Group B
- 93 percent correct for Group C

Results for Fourth-Grade Students in Q6:

- 68 percent correct for Group A
- 85 percent correct for Group B
- 86 percent correct for Group C

Results for Fifth-Grade Students in Q6:

- 72 percent correct for Group A
- 89 percent correct for Group B
- 91 percent correct for Group C

About Q5: What scene of the story did you find most appealing and why? (total of five scenes).

Figure 10

Summary of Q5 from Grade 5 Participants

Preferred scene by choice	Number of participants	Summary from children participants' feedback
S1:Theatrical opening	8	-It was like being in a real theatre play, surrounded by the energy of the crowd and the sound of cheers. -I like the opening and music. I was really looking forward to seeing what would happen next, when the button got clicked
S2: Perspective	6	-It was fun being in a "cave" , that looks mysterious -I can see the boy's face as if I am meeting him
S3 :Pop-ups Comics	11	-I like the cartoon pop-ups and vibrant colors -It makes me happy when I look at that -Fun to look at the pops-ups and I can move with them
S4 Game-like Fight	3	-The ghosts look gloomy -It's good to see the boy won!
S5. Photorealism & Animation (Ending)	4	-Happy to see the boy is back to grandmom. -Feeling emotionally connected while seeing cuddling. -I like cozy setting and lighting from window behind

.

Survey Analysis & Conclusion

The findings from this empirical study underscore the significant advantages of integrating comic language into augmented reality (AR) children's books, particularly in enhancing engagement and comprehension among young readers. The user testing, conducted with fourth- and fifth-grade students, revealed clear preferences for the different media formats presented. Notably, both grades demonstrated a strong inclination toward the comical AR format (Type C), with 37% of fourth graders and 40.6% of fifth graders selecting it as their preferred choice. This preference highlights the appeal of humor and visual storytelling elements that comic language provides, making the reading experience more enjoyable and accessible for children.

In the second phase of the study, which assessed comprehension levels across the three formats, the results consistently indicated that students who engaged with the comical AR format (Type C) exhibited the highest levels of understanding and retention. For instance, fourth graders scored an average of 4.8 on clarity and 4.5 on interest for the comical AR format, compared to 3.2 and 3.1 for the traditional graphical book (Type A). Similarly, fifth graders demonstrated even greater comprehension, with average scores of 4.9 for clarity and 4.8 for interest in the comical AR format. These results suggest that the integration of comic language and AR not only captivates children's attention but also enhances their ability to grasp and recall story elements.

The analysis of specific comprehension questions further corroborates these findings. In both grades, students interacting with the comical AR format showed the highest accuracy in identifying story details, with 90% of fourth graders correctly answering which rooms the House Elf did not visit, compared to 72% for the traditional format. Based on the feedback from Question 5 (Figure 10), the pop-up dialogue bubbles in Scene 3 were the participants' favorite,

receiving 11 votes. Additionally, the theatrical opening, which garnered eight votes, indicates that participants are more drawn to comical elements such as vibrant colors, animated bubbles, and an exciting ambiance compared to other scenes. This pattern was consistent across other comprehension metrics, indicating that the use of comic language and visual elements in AR significantly contributes to children's understanding of narrative content. Overall, the users' feedback provides compelling evidence that comic language in AR children's books serves as an effective pedagogical tool, fostering both engagement and comprehension. By integrating the unique characteristics of comic storytelling and AR technology, we can create enriched learning experiences that not only captivate young readers but also cultivate a lifelong love for reading.

Future research should continue to explore the integration of various storytelling techniques, including comical elements and their impact on literacy development, further expanding the potential of AR in educational contexts.

Discussions

Although the combination of AR technology and comical languages can positively increase students' reading interest, there are some potential concerns that educators may have regarding the shift toward the phenomena.

1. Decreased attention span: The use of animated and comical elements may lead to a decrease in attention span, as children become increasingly accustomed to instant gratification and visual stimulation. Educators may be concerned that students may not fully understand the context and nuances of the story, as AR technology may focus on visual engagement rather than deeper understanding.
2. Loss of traditional reading skills: By relying heavily on AR technology, children may lose the ability to read and understand traditional texts, potentially affecting their comprehension and literacy skills. All might cause over-reliance on technology; students might become too reliant on flashy animation and struggle to read and understand texts without the aid of AR.
3. Impact on vocabulary and syntax: The use of comical language in AR books may affect students' understanding of vocabulary and syntax, potentially leading to a decrease in linguistic proficiency.

However, we cannot ignore the benefits of integrating comical elements and AR technology in educational contexts, which are also substantial. Some potential advantages include:

1. Increased engagement and motivation: AR technology and comical elements can captivate young readers and make learning more enjoyable. Interactive storytelling and visual elements can enhance comprehension and retention of material.
2. Personalized learning experiences: AR technology can provide personalized learning experiences tailored to individual students' needs and learning styles.
3. Enhanced creativity and critical thinking: Comical elements and AR technology can encourage creativity and critical thinking, essential skills for the 21st century.

Ultimately, educators should strive to strike a balance between traditional reading skills and the benefits of AR technology. By incorporating AR and comical elements thoughtfully and judiciously, educators can create enriched learning experiences that foster a lifelong love for

reading and academic achievement.

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