The Dual Perspectives on Anthropomorphic Graphics: A Comparative Analysis of Educators' and Designers' Views

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Abstract: Objective: Anthropomorphic graphics are increasingly utilized in multimedia educational content, prompting discussions about their pedagogical efficacy and functional optimization. **Methodology:** This cross-disciplinary investigation compares educational practitioners' and interface designers' perspectives on anthropomorphic visualization in learning environments. **Main Results:** Qualitative analyses reveal divergent priorities: educators predominantly conceptualize these elements as engagement-enhancing ornaments, whereas designers advocate their dual role in information scaffolding and affective learning support. Through case studies involving geography instructors and UI designers, we identify critical determinants influencing these paradigmatic differences and propose integrative solutions for instructional material development. Empirical findings suggest that strategic anthropomorphism, **Conclusion:** when cognitively aligned with learning objectives, can synergize pedagogical effectiveness and user-centered design principles. **Recommendation:** This study, by examining perspectives across different disciplines on anthropomorphic design strategies in multimedia teaching materials, provides empirical evidence for optimising multimedia learning materials in geography. It also offers valuable theoretical and practical insights for the field of educational technology.

Keywords: Anthropomorphic Graphics, User-Interface Design, Comparative Analysis, Educator Perspectives, Designer Perspectives.

المنظوران المزدوجان للرسومات الأنثروبومورفية: تحليل مقارن لآراء المعلمين والمصممين

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ملخّص: الهدف: من خلال هذه الدراسة متعددة التخصصات، نقارن الاختلافات المعرفية بين الممارسين التربويين ومصممي الواجهات فيما يتعلق بالتصورات البشرية في بيئات التعلم. **طريقة البحث:** استخدمت هذه الدراسة منهجية دراسة الحالة، حيث أجرت مقابلات شبه منظمة مع ثلاثة مدرسين جغرافيا وثلاثة مصممي واجهات مستخدم. وقامت بتجميع النقاط المحورية لكلا المجموعتين وحددت الأسباب الرئيسية الكامنة وراء هذا الاختلاف. **النتائج الرئيسية:** يعتبر المعلمون هذه العناصر في المقام الأول كعناصر زخرفية لتعزيز المشاركة، بينما يؤكد المصممون على دورها المزدوج في بناء هياكل المعلومات ودعم التعلم العاطفي. **الخلاصة:** تشير الأبحاث التجريبية إلى أنه عندما تتوافق استراتيجيات التجسيد مع الأهداف المعرفية للمتعلمين، يمكن تحقيق تأثيرات تآزرية بين فعالية التدريس ومبادئ التصميم المتمحورة حول المستخدم. **التوصية:** تقدم هذه الدراسة، من خلال دراسة وجهات النظر في مختلف التخصصات حول استراتيجيات التصميم الأنثروبومورفي في المواد التعليمية المتعددة الوسائط، أدلة تجريبية لتحسين موارد التعلم المتعددة الوسائط في الجغرافيا. كما تقدم رؤى نظرية وعملية قيّمة في مجال تكنولوجيا التعليم.

الكلمات المفتاحية: الرسومات الأنثروبومورفية، تصميم واجهة المستخدم، التحليل المقارن، وجهات نظر المعلمين، وجهات نظر المصممين

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Introduction

Storytelling constitutes an ancient yet pedagogically adaptive method, demonstrated to enhance emotional intelligence (Shavkatovna & Alibek Kizi, 2020). Historiosophical analysis reveals anthropomorphism as a transhistorical narrative device, particularly salient in developmental literature where it mediates complex concept assimilation, particularly in children's literature (Flegel, 2023). Cross-cultural comparative studies document the widespread use of personification in folkloric traditions, helping to convey abstract ideas through culturally resonant archetypes. This tradition continues in modern narratives, where anthropomorphic characters help bridge the gap between human experiences and moral lessons (Adhuze, 2022; S & R, 2022). Furthermore, anthropomorphism plays a crucial role in the realms of art (Chun *et al*., 2009) and religion (Guthrie & Porubanova, 2020), serving as a tool for understanding and connecting with the world. Anthropomorphism involves attributing human-like characteristics, emotions, or intentions to non-human entities (Epley *et al*., 2007). Contemporary semiotic research positions anthropomorphism as a fundamental cognitive heuristic, facilitating epistemic engagement through embodied simulation (Białek, 2024).

Technological convergence has propagated anthropomorphic applications across diverse sectors: social robotics designed with human-like characteristics or behaviors can facilitate smoother interactions by enhancing human relevance and comprehensibility (Kühne & Peter, 2023; Singh, 2023). Endowing brands with human traits can make products more relatable and emotionally appealing, thereby strengthening brand image and consumer loyalty (Pramesti & Harsono, 2023). In illustration and visual storytelling, anthropomorphism is utilized to create resonant images that effectively convey emotions and themes. By transforming design elements into human-like forms, artists can evoke empathy and communicate messages more powerfully (Y. Chen & Yuan, 2023; S & R, 2022). The widespread use of anthropomorphism highlights its connection to human cognitive process. Individuals often project human-like qualities onto non-human entities to simplify complex interactions or reduce cognitive load. This trend is particularly evident in human interactions with tools and technologies, often attributing intentions or emotions to them (Haslam, 2023).

As a subfield of visual communication, user interface (UI) design relies on principles such as color theory and layout to create aesthetically pleasing and functional interfaces. These elements aid in the effective organization of information and in directing user attention (Yang, 2023). However, with a focus on digital interfaces, there is an increased emphasis on interactivity and user experience, which necessitates that UI design accurately and efficiently conveys visual information while also addressing how to guide users through specific tasks or functions. The effective use of contrast and hierarchy in user interface design ensures that key information is prominently displayed and easily distinguishable, which is crucial for user navigation and task completion (Bhimanapati *et al*., 2024). In the realm of UI design, anthropomorphic graphic design strategies involve integrating human-like characteristics into design elements to enhance user interaction and engagement, while also fostering an emotional connection between users and the design content (J. Chen, Guo, *et al*., 2024; Janson, 2023). The essence of anthropomorphic design lies in its ability to create a sense of intimacy between users and design elements. In collective human-computer

decision-making, anthropomorphism reduces emotional distance, facilitating a natural connection between users and systems, thereby enhancing familiarity and trust (André*et al*., 2018). Incorporating cute elements into anthropomorphic interfaces can mitigate negative perceptions of system errors, ultimately improving user experience and satisfaction (Cheng *et al*., 2020). In specific design practices, designers enhance users' emotional resonance by attributing human characteristics (such as expressions and actions) to design elements. By fostering greater user interaction and engagement, thereby facilitating more effective information transmission and improving user experience.

When the users of the interface are specifically learners, this strategy has garnered the attention of educational technology researchers. The design of learning interfaces focuses on educational outcomes and necessitates the incorporation of pedagogical strategies into user interface design (Faghih *et al*., 2013). Given the need to integrate teachers' knowledge and teaching beliefs, the design of educational interfaces requires collaboration between educators and designers (Perry & Schnaid, 2012). In other words, learning interfaces represent a subset of the field of interface design. Within the domain of learning interfaces, anthropomorphic graphic design strategies are employed to enhance learners' user experience and learning outcomes. Anthropomorphic graphics can effectively capture and maintain learners' attention, which is crucial for enhancing comprehension and facilitating knowledge transfer (J. Liu & Sanmugam, 2024a). The incorporation of anthropomorphic elements in multimedia interfaces can enrich the user experience by fostering emotional engagement and increasing the relevance of interactions (Tuah *et al*., 2016). Employing anthropomorphic design can evoke positive emotions and boost intrinsic

motivation, which in turn supports improved learning outcomes (K. Liu & Su, 2024; Schneider *et al*., 2019). A systematic review and meta-analysis revealed that facial anthropomorphism in learning materials significantly enhances learning outcomes, including transfer, retention, and comprehension, with effects ranging from moderate to strong (K. Liu & Su, 2024).

However, the results of studies are not always consistent. In Mayer and Estrella's (2014) study, they found that "students are more motivated to engage in appropriate cognitive processing during learning when the relevant graphics in a lesson are redesigned to be more appealing" Figure 1 shows an example used in their study. Stárková *et al*. (2019) used learning materials similar to those in Mayer and Estrella (2014) (Figure 2) but reached a different conclusion , "anthropomorphisms may not always be beneficial; though their inclusion in learning materials does not harm learning"
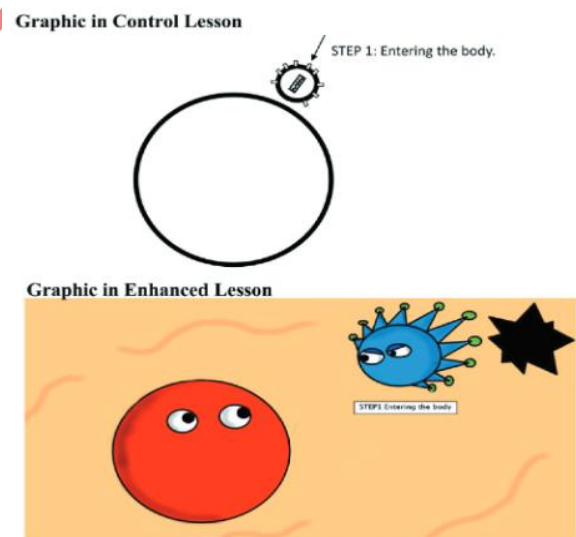
Figure (1): An example of anthropomorphic graphics used by Mayer and Estrella (2014).
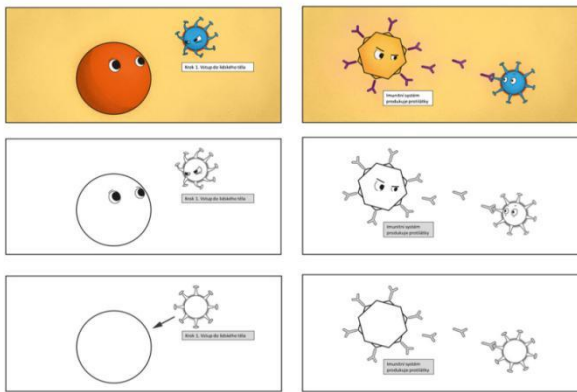
Figure (2): An example of anthropomorphic graphics used by Stárková *et al*. (2019).

Schneider *et al*. (2019) indicate that anthropomorphic features in multimedia learning materials can enhance student performance, with this enhancement being related to the degree of anthropomorphism present in the materials. High levels of anthropomorphism may increase cognitive load, particularly among younger students, potentially leading to negative impacts on learning outcomes (Schneider *et al*., 2019). Posits that anthropomorphic graphics may not significantly affect learning outcomes unless they serve an instructional purpose rather than merely decorative (Slabbert *et al*., 2022). While anthropomorphic design can enhance motivation and emotional engagement, its effectiveness in improving learning outcomes may depend on the learner's age and prior knowledge (Schneider *et al*., 2019). Although non-verbal cues such as gestures and facial expressions are intended to enhance human likeness, their effectiveness in improving users' perceptions of online educational platforms is not always significant (Klein, 2016).

The research conducted in the fields of visual communication and educational technology reveals a consensus among researchers that anthropomorphic graphics or representations can enhance user interaction and emotional resonance, thereby improving the overall user experience. Notably, the educational technology domain further emphasizes that this enhanced user experience can facilitate learners' attention, comprehension, and knowledge transfer. Both fields, however, highlight the necessity of regulating the degree of "human likeness" in anthropomorphic design to prevent eliciting discomfort or increasing cognitive load. Human factors research identifies cognitive-load optimization as a critical determinant of anthropomorphic design efficacy, necessitating careful human-likeness calibration to avoid the uncanny valley phenomenon (Xiao & He, 2020). Educational technology studies reveal context-dependent outcomes, with moderate anthropomorphism positively correlating with conceptual retention (K. Liu & Su, 2024), yet excessive embodiment potentially impairing novice learners' information processing (Schneider *et al*., 2019).

It is observed that while the visual communication field widely acknowledges the effectiveness of anthropomorphic design strategies in facilitating information transmission, the educational technology field focuses more on the role of anthropomorphism in cognitive processes. Cognitive processes encompass multiple stages, with information transmission being one of them. The theory of elemental cognitive skills posits that cognitive tasks consist of fundamental information processing units. These units can be combined and transferred across tasks, underscoring the fundamental role of information transmission in learning and skill acquisition (Taatgen, 2013).

Due to disciplinary differences, previous research has primarily focused on the application and exploration of anthropomorphism within the distinct realms of UI design and educational technology. There has been limited attention paid to the inherent contradictions and potential synergies arising from interdisciplinary applications of anthropomorphism, particularly in contexts where collaboration between designers and

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educators is essential for material development. This indicates a scarcity of exploration into the conflicts and integrations that emerge within an interdisciplinary framework. To address this gap, this study investigates the perceptions and attitudes of two key groups—UI designers and educators—toward anthropomorphic design, analyzing their commonalities and differences. The aim is to explore how the relatively mature concepts of anthropomorphic design in the field of interface design can be effectively transferred and applied to the design practices of educational technology interfaces, thereby fostering deeper integration and collaborative development between the two domains.

To explore the specific differences in perspectives between designers and educators regarding the role of anthropomorphic graphics in facilitating information transmission, this study conducted a case study involving interviews with six experienced professionals from the fields of interface design and geography education.

The research questions are as follows:

RQ1: What similarities and differences exist between educators and designers in their perceptions of the functions of anthropomorphic graphics?

RQ2: How can we balance the perspectives of educators and designers in the design of educational materials to optimize the teaching effectiveness and user experience of anthropomorphic graphics?

Literature review

Anthropomorphism and emotion design

This section will discuss anthropomorphic and emotional design from the perspectives of UI design and multimedia teaching, respectively.

From a UI design perspective: Based on the theory of emotional design, UI designers strive to achieve a balance between functionality and emotionality by endowing interface elements with anthropomorphic characteristics, thereby enhancing user experience (Norman, 2004). The theory of emotional design, proposed by Norman (2004), posits that emotions play a crucial role in design. Norman (2004) categorizes emotional experiences into three levels: the visceral level, which focuses on users' initial sensory reactions to design, such as visual appeal and intuitive feel; the behavioral level, which emphasizes usability and the smoothness of interaction, representing a fusion of functionality and emotional experience; and the reflective level, which pertains to users' deeper emotional and value judgments about a product, serving as a source of enduring appeal. These dimensions can align with anthropomorphic design elements to enhance user experience (Xiao & He, 2020). Users tend to have more positive attitudes and greater willingness to use systems with human-like features because these designs are more compatible with human social behavior and expectations (Shi *et al*., 2024).

Anthropomorphic interfaces simulate interpersonal communication, making interactions more relevant and engaging. Integrating verbal and non-verbal cues in conversational agents can enhance perceived anthropomorphism, thereby improving user interaction (Seeger *et al*., 2021). Anthropomorphic design can amplify positive emotional responses and mitigate negative emotions, alleviating consumer anxiety and fostering psychological intimacy, which effectively shortens the psychological distance between consumers and products (C. Sun *et al*., 2024). A study on beverage brands revealed that consumers exhibited a stronger brand attachment when exposed to anthropomorphic brand elements, such as mascots, compared to non-anthropomorphic counterparts (Nguyen *et al*., 2024). Anthropomorphic design not only strengthens emotional connections but also influences user behavior through emotional

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guidance. For instance, health applications encourage users to achieve exercise goals by employing anthropomorphic characters, thereby stimulating users' intrinsic motivation (Xiao & He, 2020).

Icons and emojis are common anthropomorphic elements in UI design, with emoticons and emojis intended to convey emotions and compensate for the lack of non-verbal cues in digital communication. They serve as artifacts that leverage facial recognition mechanisms to effectively communicate emotions and social information online (Viola, 2024). Anthropomorphic interfaces, such as avatars and interface agents, can enhance long-term user engagement by mimicking human social interactions, thereby fostering a stronger emotional connection between users and digital interfaces. This connection can contribute to increased long-term user engagement and satisfaction, even in the face of operational errors (Tuah *et al.*, 2016). Furthermore, incorporating cuteness into anthropomorphic interfaces can significantly reduce users' perceived severity of system errors (Cheng *et al.*, 2020). This suggests that users generally prefer anthropomorphic feedback over non-anthropomorphic feedback, as it aligns more closely with human social behavior and expectations (Murano, 2002, 2006). Higher levels of anthropomorphism in virtual agents within augmented reality environments are associated with improved cognitive performance and social presence, unless only voice is utilized (Mostajeran *et al.*, 2022). Additionally, users exhibit greater acceptance of intelligent agents that employ simplified anthropomorphic images (Shi *et al.*, 2024).

From a multimedia educational perspective: After achieving some progress in the field of interface design, anthropomorphic design gradually gained attention in the domain of multimedia education research. Emotional design should be considered a critical component of instructional design (Um *et al.*, 2012). Mayer and Estrell (2014) further developed this perspective, suggesting that making graphics more visually appealing and personalized can facilitate deeper cognitive processing and improve learning outcomes. Moreover, this research emphasized the necessity of leveraging emotional processes to activate cognitive processes without diverting attention from essential content. As a strategy within emotional design for multimedia learning, anthropomorphic design has been extensively studied in educational interfaces in recent years. This section explores the role of anthropomorphic design in fostering emotional engagement, learning motivation, and learning outcomes.

Anthropomorphic characters can convey emotions through facial expressions, tone of voice, and gestures, contributing to the creation of a more engaging learning environment. For instance, empathic agents featuring emotional facial expressions and vocal tones can provide feedback aligned with learners' emotional states, thereby enhancing engagement and motivation (Moridis & Economides, 2012). Emotional pedagogical agents in virtual learning environments can identify and respond to students' emotional states, motivating them to participate more actively in learning activities (Alencar & Netto, 2020). The emotional connection fosters a greater willingness to engage with learning materials. Anthropomorphic design can also elicit positive emotional responses, which are linked to improved learning outcomes. For example, Wang *et al.* (2022) demonstrated that integrating color and anthropomorphic features in multimedia courses enhances positive emotion ratings and leads to better transfer test scores. Facial anthropomorphism in multimedia learning materials has been shown to significantly improve learning outcomes,

including transfer, retention, and comprehension. These improvements are attributed to the positive emotions and intrinsic motivation elicited by anthropomorphic design (K. Liu & Su, 2024). In contexts such as learning about viruses, anthropomorphic representations can make complex topics less intimidating, reducing learners' fear and anxiety (Menendez *et al*., 2024).

The degree of anthropomorphism can influence learning outcomes, with higher levels of anthropomorphism leading to greater intrinsic motivation and higher aesthetic scores. However, these effects may vary depending on learners' age and prior knowledge (Schneider *et al*., 2019). Prior knowledge plays a critical role in learners' responses to anthropomorphic features. Students with greater background knowledge are better equipped to integrate anthropomorphic cues into their learning process, thereby enhancing their educational experience (Schneider *et al*., 2019). Furthermore, while anthropomorphic elements can create a more enjoyable learning experience, they may also lead students to perceive tasks as easier, reducing their intellectual effort (Uzun & Yıldırım, 2018). Only colorful and engaging designs were found to significantly influence recall scores, whereas anthropomorphic features did not have a notable impact on learning transfer. This suggests that although such elements may improve emotional engagement, they might not effectively enhance cognitive engagement or learning outcomes.

While anthropomorphic design can help reduce perceived difficulty and intrinsic cognitive load, the positive emotional responses it elicits do not automatically translate into increased intrinsic motivation for learning (Liew *et al*., 2022). Some studies have reported significant improvements in memory and comprehension, while others have found no notable effects. These discrepancies may be attributable to variations in the context and implementation of anthropomorphic design (K. Liu & Su, 2024; Slabbert *et al*., 2022). Although anthropomorphism can enhance engagement, there is a risk of cognitive overload, particularly among younger learners or when anthropomorphic features are overly complex or excessive (Schneider *et al*., 2019).

Anthropomorphisation and cognitive aids

This section will discuss anthropomorphism and information delivery, as well as cognitive aids from the perspectives of UI design and multimedia teaching, respectively.

From a UI design perspective: The theoretical foundation of anthropomorphic graphic design stems from the human tendency to attribute human characteristics to non-human entities (Epley *et al*., 2007). In web design, interactive websites featuring a variety of aesthetic elements can enhance users' perception and recall of information, underscoring the significance of a multi-channel approach in improving memory and comprehension (Al Said & Al-Said, 2022). The anthropomorphic features present in intelligent agents can significantly influence user acceptance by enhancing the perceived utility, usability, and trustworthiness. Notably, simplified anthropomorphic images have been found to increase user acceptance more effectively than complex anthropomorphic images (Shi *et al*., 2024). Color coding represents another dimension of information depth that can enhance memory retention and emotional arousal. It serves as a visual cue that aids users in more effectively creating mental maps and navigating information, thereby improving memory capacity (Kim, 2020). Colorful anthropomorphism can significantly reduce task completion times, indicating that such designs can enhance the efficiency of understanding and processing information (Su & Liu, 2024). The incorporation of

anthropomorphic elements can also influence cognitive processing by providing familiar cues, assisting users in more effectively navigating and interpreting information. This can lead to faster task completion and a better understanding of complex data (Su & Liu, 2024).

The effectiveness of anthropomorphic design hinges on the balance between human-like characteristics and functionality. Designs that are overly human-like can sometimes disrupt users' positive emotions and attitudes, suggesting that a moderate level of anthropomorphism may be optimal (Zhang *et al*., 2023). Anthropomorphic design can enhance emotional engagement by making interfaces more relatable and captivating. This emotional connection can improve attention and memory, as users are more likely to remember content that elicits an emotional response (Xiao & He, 2020). Anthropomorphic assistants can provide error messages or operational suggestions in a more humanized manner by integrating human-like attributes, potentially increasing user acceptance and facilitating adjustments. In experiments focused on learning sewing, anthropomorphic feedback yielded better outcomes compared to non-anthropomorphic feedback (Murano & Sethi, 2011).

However, the effectiveness of anthropomorphic design may be compromised if visual and conversational cues are inconsistent. When these cues align, users tend to disclose more information, underscoring the importance of coherent design across different dimensions (J. Chen, Li, *et al*., 2024).

From a multimedia educational perspective: The Cognitive-Affective Theory of Multimedia Learning (CATML) builds upon the Cognitive Theory of Multimedia Learning (CTML) by integrating emotional elements and examining the roles of cognition, emotion, and motivation in the learning process. It expands on how learners receive information through visual and auditory channels and subsequently store it as long-term memory through selection, organization, and integration processes. CATML provides a framework for designing multimedia courses that leverage cognitive and emotional elements, including the use of technologies such as slide-sharing and video-sharing platforms to create interactive and engaging learning experiences (Cavanagh & Kiersch, 2023). By fostering positive emotions to students, especially the promoting of self-concept, can stimulate their enjoyment of learning and enable them to derive greater pleasure from the learning process(Daher, 2022). The depth of information processing is crucial for effective memory and retrieval. Different levels of processing can either facilitate or hinder the achievement of educational objectives, with visualization playing a key role in the transformation of information for storage and retrieval (Dwyer & Dwyer, 1987).

Learners actively select relevant information, organize it into coherent structures, and integrate it with existing knowledge, a process that is crucial for transferring information from working memory to long-term memory (Cavanagh & Kiersch, 2023; Mayer, 2024). And when the information is passed to the students' in an interesting and attractive image, the learning outcomes are often significantly more effective(Kareem Farrajallah, 2017). Research by emphasizes that our perception is not solely based on sensory information but is significantly influenced by prior knowledge acquired through experience. Prior knowledge plays a role in predictive coding, assisting the brain in making inferences about sensory input (Brodski-Guerniero, 2018). Students utilise the stimuli they receive at the game interface by reconstructing prior knowledge

and relating it to what they are experiencing (Shawalludin *et al*., 2021). This process is vital for interpreting anthropomorphic features, as it involves using prior knowledge to predict and understand human-like characteristics in non-human entities. In educational settings, learners with higher prior knowledge outperform those with less knowledge in retention and understanding tasks, as they are better equipped to integrate new information with existing knowledge (Arslan-Ari *et al*., 2020). In other words, learners with greater prior knowledge may engage more actively in the learning process and process information more deeply, which is essential for retention and comprehension.

Anthropomorphic design enhances the intuitiveness and appeal of information through the use of anthropomorphic visual elements, such as cartoon characters, or linguistic expressions, like friendly prompts, thereby increasing learners' initial engagement with multimedia content (Atkinson, 2002; Moreno & Mayer, 2007). The degree of anthropomorphism influences cognitive load, with a moderate level of anthropomorphism being the optimal choice for maintaining attention without overwhelming learners (Schneider *et al*., 2019; Zhang *et al*., 2023). Incorporating characteristics that evoke positive emotions, such as anthropomorphism, can enhance engagement through positive emotional responses. This, in turn, can facilitate deeper processing and retention of information (Özgür & Altun, 2021). In the context of understanding human diseases, anthropomorphic characters have been employed to represent disease processes, enabling students from diverse scientific backgrounds to comprehend these concepts (Brossard Stoos & Haftel, 2017). Integrating visually anthropomorphic narratives into science education can improve students' understanding of abstract concepts, such as the

particulate nature of matter.

These narratives can assist students in developing anthropomorphic discourse, which aids in conceptual understanding (Türkoguz & Ercan, 2022). The emotional connections stimulated by anthropomorphic design can enhance comprehension and retention of information, as evidenced in multimedia learning environments where anthropomorphic elements can reduce cognitive load and improve learning outcomes (Liew *et al*., 2022).

Although anthropomorphism is a default response that can be easily activated, particularly in situations of limited cognitive resources, individuals tend to rely more on automatic processes when cognitive resources are constrained. This reliance may lead to misunderstandings or an overdependence on anthropomorphic cues (Spatola & Chaminade, 2022). Furthermore, Slabbert *et al*. (2022) argue that when anthropomorphic graphics are used solely as decorative elements, they fail to enhance comprehension or retention of information.

Method

To supplement our understanding of teachers' perspectives on the role of anthropomorphic graphics in facilitating information transmission, and to explore the differences between their views and those of designers, we conducted a qualitative interview study. Our research aimed to investigate whether anthropomorphic graphics can enhance the communication of information, particularly regarding complex concepts. Qualitative research emphasizes understanding phenomena from the perspective of the participants, allowing for a more open exploration of their experiences and perceptions (Haki *et al*., 2024). This approach allows for a more nuanced consideration of the context and a deeper examination of the subjects within the framework of the research

questions. Compared to quantitative methods, this approach yields higher content validity while offering deeper generalizability (Kaplan & Maxwell, 2005).

Participants

Purposive sampling selected six domain experts from China: 3 UI designers (M=34, SD=1) and 3 geography teachers (M=32.7, SD=2.52). The UI designers have been engaged in interface design for over 9.8 years, and the high school geography teachers have been engaged in high school geography education for 8.5 years and have been using multimedia educational resources frequently for the last 7 years. Respondents in each group included one male and two females.

Procedure

All interviews for this study were conducted using the widely utilized video conferencing platform "Tencent Meeting" in China which approach ensured the convenience of participants. The interview outlines were tailored to the specific circumstances of each participant group, with each session lasting approximately 45 minutes. Prior to the interviews, the researcher provided a brief introduction to the study's themes and objectives to facilitate more targeted responses from participants. The interviews with UI designers included 30 questions, primarily addressing five dimensions: 1) the fundamental principles of interface design; 2) commonly employed strategies in interface design; 3) the role of anthropomorphic design; 4) user feedback on anthropomorphic design; and 5) factors to consider when implementing anthropomorphic design. The interviews with high school geography teachers comprised 22 questions, focusing on three dimensions: 1) factors influencing student attention in multimedia teaching environments; 2) factors affecting learning outcomes; and 3) perceptions regarding the use of anthropomorphic graphics.

To ensure the reliability and validity of participants' responses, we incorporated control questions during the interview process. Specifically, we inquired about their relevant work experience and multimedia usage (e.g., "How long have you been using multimedia for teaching? -- directed at high school geography teachers," "Have you engaged in interface design related to education? -- directed at UI designers"). We also explored their experiences with anthropomorphism (e.g., "Have you utilized anthropomorphic graphics in your teaching? -- high school geography teachers," "Have you employed anthropomorphic elements in your design projects? -- UI designers"). Although multimedia tools such as smart blackboards are utilized in high school classrooms, one interviewed teacher, due to his personal teaching style, infrequently employed multimedia tools. Consequently, we excluded this participant's interview data from the study and subsequently recruited a male high school geography teacher who met the interview criteria. With the participants' consent, we initiated recording and transcription via "Tencent Meeting," and after the interviews concluded, we meticulously proofread both the audio recordings and the transcribed content.

Data Analysis

The proofread raw data were coded using Nvivo software (Version 11), and semantically similar or repetitive statements (Level A) were compiled into meaning clusters (Level B). To ensure meaningful analysis, questions did not have to be present in all participants' narratives. Even experiences from only a single participant can be theoretically important, and generality is not a primary concern of phenomenology (Creswell, 2015).

UI designers

Designers generally adhere to the principle of "form follows function" in interface design,

consistently asserting that "visual appeal should serve the information hierarchy of the interface." They widely believe that "anthropomorphic graphics can act as a medium for information transmission," leaning towards the notion that "appropriate graphic design aids in information processing, communication, and comprehension." In their design projects, they also uniformly follow the principles of accurate "mapping" and appropriate "metaphor." Mapping in interface design refers to the relationship between controls and their effects, aiming to ensure that users can predict the outcomes of their actions based on the interface design. Effective mapping renders the interface intuitive and reduces the user's learning time (Sarasúa *et al*., 2019). Metaphor in interface design involves employing familiar concepts to assist users in understanding new or complex systems, leveraging users' existing knowledge to make the interface more relevant and easier to navigate (Firat & Yurdakul, 2016; Z. Sun *et al*., 2022). Furthermore, UI designers place significant emphasis on typography and layout, believing that "appropriate fonts and typography can enhance visual reinforcement and information aggregation."

Currently, in the field of UI design, anthropomorphic design is predominantly applied in "onboarding" for new features upon product launch, "feedback" during task completion, and "virtual assistants," with the primary function of establishing an emotional connection with users. Regarding the use of anthropomorphic elements, there is a common concern about cognitive differences arising from age, cultural background, and prior knowledge, which may affect the effectiveness of the information conveyed by these elements. Additionally, the use of anthropomorphic elements should involve selecting appropriately metaphorical representations, as overly concrete designs of anthropomorphic graphics may hinder recognition; users tend to identify simple, outlined images more readily than intricate details. Anthropomorphic elements should only appear at necessary touchpoints and should not be overused across every page, as this could lead to user aversion.

It is noteworthy that one of the UI designers, referred to as P3, previously participated in a design analysis project focused on skeuomorphism. This initiative was grounded in functionality, with the aim of ensuring that skeuomorphic icon designs could more effectively align with user cognition. After two years of both quantitative and qualitative research, the findings were positive, and the corresponding design principles were subsequently applied to actual interface design projects.

Table (1): UI designers' perspectives on anthropomorphic graphics for interface design in high school geography education.

Dimension	Themes (Level B)	Mentions (n=3)	Exemplary Statements (Level A)
Core Principles of UI Design	Visual appeal serves the information hierarchy of the interface	3	Depending on the most important operation at the moment, I would definitely give you the strongest guidance visually in terms of position, size, and color. (P1)
Common strategies used in interface design	Form follows function	3	There is definitely a balance between functionality and aesthetics, and we are more interested in serving the function. If it affects the user's time and understanding, then we need to prioritize to find a presentation that solves the problem of recognition and understanding, and then

Dimension	Themes (Level B)	Mentions (n=3)	Exemplary Statements (Level A)
			consider how to make it more aesthetically pleasing. (P3)
	Fonts and typography can be visually enhanced	3	Like some of the key messages, there's definitely some reinforcement in the visual representation. (P1)
	Fonts and typography can help with information aggregation	2	According to the principle of relevance, similar information should be clustered into one board. (P2)
	Metaphors and mappings	3	That's probably just a more precise mapping relationship. It's important to be able to map this, like with ballet it's like thinking about spinning in circles, and then for example the hare is fast and the tortoise is slow. (P1) We need to think about what kind of object image can solve both the user recognition problem and the understanding ambiguity problem. (P3)
	Animation effect	3	The animation is the degree of cueing, to show the feedback of the real physics, and the rationalization of this application, which will probably be a principle, and not overused. (P1)
The Role of Anthropomorphic Design	Emotional links	3	Nowadays, the overall use of anthropomorphism is still inclined to the function of emotional transmission and emotional guidance. (P3)
	Anthropomorphic graphics can be used as a medium for messaging	2	I feel that anthropomorphic graphics are a transitory role, acting as a carrier in the process of information transfer. (P2)
User's Feedback with Anthropomorphic Design	Positive feedback	3	The user is able to get some positive feedback during his interaction with the product, which then stimulates him to play and use it continuously. (P3)
	Negative feedback	2	For example, going for useless cues too often in the vicarious process can make users feel a bit redundant (P2)
Factors to be consider of in anthropomorphic design	Cognitive Differences	2	Just like a student of different ages, for example, his anthropomorphic style may be not quite the same (P2) The user's memory mechanism is to mobilize some of his pre-existing cognition inside to match what he sees and then to understand what it is. (P3)
	Factors to consider in anthropomorphic design	3	People will recognize contours more than some other details (P3)
	Anthropomorphic design should be present when necessary	2	I think we first have to see if the key message is suitable for anthropomorphization, and if so, find the graphic that fits best. (P1)
	Degree of anthropomorphization affects user perception	2	It is not that the more realistic the user will be able to quickly recognize it, but rather, if you make it too complex and realistic, you will lose his relevance and the user will increase the cost of comprehending some information (P3)

*Note.*P1=Participant 1; P2=Participant 2; P3=Participant 3

High School Geography Teachers

Through interviews, we learned that multimedia tools are commonly employed when introducing new lessons, particularly when the content to be learned is distant from students' real-life experiences. However, during the review phase, multimedia teaching is rarely utilized, as students already possess a certain level of understanding of the material. Images, animations, and videos can effectively capture students' attention; however, videos are only used when absolutely necessary due to their significant consumption of class time. Additionally, teachers' verbal and non-verbal behaviors, especially mistakes, can easily lead to student errors. The primary factors influencing comprehension and retention are the logical structure of the knowledge presented and the students' prior knowledge. In terms of multimedia materials, animations can serve as valuable aids. Among the respondents, two had experience using anthropomorphic elements, and they generally believed that the main function of anthropomorphic graphics is to enhance page decoration and increase classroom engagement.

Regarding the use of anthropomorphic graphics in high school geography instruction, there is a consensus that while it adds an additional step for students in interpreting graphics, it ultimately aids in their understanding and memory, thus not constituting a cognitive burden. In past experiences, most students provided relatively positive feedback; however, some high-achieving students may exhibit dismissive reactions. They believe that, overall, anthropomorphic graphics are more beneficial for students with lower performance and learning difficulties. Due to concerns that students may focus too much on anthropomorphic figures at the expense of the learning content, they suggest that such graphics should be used judiciously for teaching challenging concepts rather than appearing on every page.

Additionally, all three respondents indicated that aesthetic considerations of the PowerPoint interface are generally not taken into account during regular class sessions. It is only during public lectures or performance classes that aesthetic factors are considered, leading to careful formatting. However, it is noteworthy that although the three interviewed educators claimed to disregard the visual appeal and layout of their slides, they all mentioned organizing the informational hierarchy of course content through the use of font type, size, or color.

Table (2): High School Geography Teachers' Perceptions of Anthropomorphic Graphics for Interface Design in High School Geography Education.

Dimension	Themes (Level B)	Mentions (n=3)	Exemplary Statements (Level A)
Factors affecting attention	Pictures, motion graphics, videos	3	What particularly attracts students' attention are some pictures, just the kind of natural landscape pictures I mentioned earlier, or video content. (P6)
	Content and Format of Page Presentation	2	If there are too many types of multimedia presentations, including text, video, and audio presentations, it may be easy to be distracted. (P4)
	Teachers' words and actions	2	Then there are the little gaffes that they like to get up in arms about. Sometimes I'll purposely make some loophole out of it and then draw their attention to it so they can catch it. (P5)

Dimension	Themes (Level B)	Mentions (n=3)	Exemplary Statements (Level A)
Factors affecting the effectiveness of comprehension and memorization	Prior knowledge	3	The student's prophetic experience is not enough, or he himself did not study seriously, this piece just it will be easy to go wrong, he will not be able to distinguish, which one is weakening, which one is insulating, and can't catch the key point. (P5)
	Teachers' refinement of knowledge	1	It's mainly related to the student's own methodology and the teacher's refinement of knowledge (P4).
	Logic of knowledge or mind maps	2	If it's memorization, I think something like mind mapping is something that is more helpful for students to go through. (P4)
	Motion graphics	3	Moving pictures present the process of iceberg movement, and he knows the glacial landforms very clearly at once, without even bothering to talk about it, and he doesn't have to memorize it or analyze it. Just look at the process and it's clear at a glance. (P6)
Thoughts on the use of anthropomorphic graphics	Used anthropomorphism before	2	Sometimes, for the sake of convenience, some anthropomorphic images are used instead when taking notes in class. For example, "good" is a smiley face and "bad" is a crying face. (p5)
	Decorative and interesting	3	The first is that it enhances its interest, because the student relatively speaking he prefers something interesting. (P4)
	For abstract concepts far away from daily life (especially physical geography)	3	It could be more in the middle of physical geography, as it is relatively one of the more challenging parts to understand. (p4)
Factors to consider in anthropomorphic design	Does not constitute a cognitive burden	1	I think it's increased, but to be precise, it's increased, but it's more comprehensible to them. Without the anthropomorphisms, he wouldn't understand at all and he wouldn't be able to remember. After it is added, it is so that he can remember it and make it his own, so it can't be called a burden. (p5)
	Most students showed positive feedback	3	Most of the students are more interested because they will this marvel if this thing you draw looks good and they will this laugh if it doesn't. (P4)
	Worried that students will focus on anthropomorphic images and lose sight of what they are learning	2	There was also a bit of concern during the lesson that some of the students would be too focused on just understanding the surface of these anthropomorphisms and lose sight of understanding the content of the lesson itself that was to be presented. (p4)
	Applied to Teaching and Learning Difficulties	3	I think anthropomorphic graphics it should appear where he needs, that is, appear in the more difficult places. So at the beginning of the design, it is based on a certain understanding of the students' teaching difficulties, and then go to add these anthropomorphic graphics at the right time. (p4)
	Increased amount of lesson planning	3	If an anthropomorphic design is used, consideration will be given to whether or not it needs to take up more time when preparing for a lesson, as relatively speaking high school geography it still has a large amount of lesson preparation (p4)
Layout design	Lack of attention to layout and aesthetics	3	Primary consideration is given to content presentation and logical relationships, generally not typography (p6)

Note. P4=Participant 4; P5=Participant 5; P6=Participant 6

Findings

Both groups believe that 1) animated graphics perform better in capturing attention relatively; 2) the primary function of anthropomorphic graphics is to serve as an emotional link, providing students or users with a more positive emotional experience; 3) varying levels of prior knowledge lead to cognitive differences, with prior knowledge in the student population primarily reflecting their foundational knowledge; 4) anthropomorphic design should only be employed when necessary to avoid overuse, focusing more on the challenging aspects of teaching.

The UI designer group acknowledges the role of graphics and anthropomorphic images in conveying information, guided by certain design theories. In contrast, the educator group contends that while anthropomorphic graphics do have some informational value, their main function is decorative, enhancing the engagement of the classroom. Educators are primarily concerned that students may focus on the anthropomorphic images or characters, thereby neglecting the learning content that the graphics are intended to convey; in their view, anthropomorphic representations appear particularly concrete. Meanwhile, designers are more focused on the degree of anthropomorphism, as extensive design practice indicates that the level of anthropomorphism can influence user cognition, with users demonstrating a stronger ability to recognize simplicity and outlines over details. The use of motion graphics was recognised by both groups in a way that we did not initially anticipate. One possible reason why video material can be distracting to students is that visual and auditory content compete for the brain's working memory capacity and thus interfere with learning, when a relatively streamlined form of media may be a better choice (J. Liu & Sanmugam, 2024b).

Furthermore, the designer community frequently references "metaphor" and "mapping," emphasizing the degree of alignment between graphics and the conveyed information. This reflects a greater concern among designers regarding whether anthropomorphic graphics can accurately communicate information, a point that was not mentioned by the educator group. This discrepancy suggests that educators' understanding of anthropomorphic graphics remains largely superficial, primarily viewing them as decorative elements, with limited insight into their role in facilitating information transmission.

Through our analysis, we have identified that many of the concerns expressed by educators have corresponding solutions within the field of UI design, which have been established as design principles through extensive practice. However, due to differences in industry and discipline, these relatively mature design principles are seldom, if ever, applied in the design of multimedia teaching materials for high school geography. The reasons for these disparities are multifaceted, but we believe the most significant factor is the difference in aesthetic positioning. Interface designers regard visually appealing presentations with aesthetic considerations as functional, whereas in educational contexts, aesthetics are often perceived as supplementary content. This

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fundamental cognitive divergence leads to distinct approaches in the daily practices of the two groups.

Therefore, when developing multimedia teaching materials for the field of geography, researchers advocate for an interdisciplinary approach that integrates perspectives from practitioners in both domains. Initially, it is essential to select teaching content related to physical geography, systematically organizing the logical hierarchy and knowledge challenges within the geography curriculum. This process involves identifying appropriate metaphors and anthropomorphic graphics that align with the content, ensuring that the graphics adhere to principles of simplicity and contouring, thereby minimizing intricate details. Furthermore, anthropomorphic graphics should not appear on every page; rather, they should be strategically placed at critical knowledge challenges, ideally presented in animated formats. Additionally, the design of the pages should primarily feature images alongside textual information, utilizing animations at key points while avoiding the inclusion of videos unless absolutely necessary. Lastly, during the page design process, incorporating minor errors that do not detract from the main content can foster student interaction, enhancing their sense of achievement in correcting these mistakes.

Table (3): Differences between the two groups' views on the use of anthropomorphic graphics in geography multimedia teaching and learning.

Dimension	Designers' Perspective	Educators' Perspective
Primary Function	Cognitive-affective mediator	Emotional catalyst
Design Priority	Information mapping fidelity	Present content logically
Anthropomorphism Role	Conceptual metaphor system	Mnemonic decorative element

Discussion and Conclusion

As primary stakeholders, educators and designers often hold differing perspectives on the role of anthropomorphic graphics in learning environments. Educators primarily focus on the direct transmission of knowledge, aiming to provide multimedia learning materials that are logically clear and efficiently concise. They view anthropomorphic elements as decorative, enhancing student engagement, particularly for those with lower academic performance. From this standpoint, anthropomorphic graphics may be perceived as superficial. In contrast, designers argue that these graphics can foster emotional engagement and facilitate information delivery, enhancing cognitive processing and user experience, thus holding significant potential for creating appealing learning environments. Research findings indicate that while both groups acknowledge the importance of anthropomorphism in capturing attention and promoting emotional connections, their emphases differ markedly, highlighting the disparity between the aesthetic and functional dimensions of educational design. A key distinction lies in the emphasis on functionality. User interface designers operate within a framework where

aesthetics and information hierarchy are interwoven, ensuring that anthropomorphic elements enhance clarity and user experience without overwhelming cognitive resources. Conversely, educators prioritize instructional effectiveness, often considering visual embellishments secondary to content delivery. This contrast reflects the broader differences in how design and education prioritize visual communication and cognitive load management.

Furthermore, designers actively consider principles such as "mapping" and "metaphor" to optimize the effectiveness of anthropomorphic graphics, while educators seldom reference these concepts. This indicates a potential gap in the application of established design principles within educational multimedia materials. Such a gap underscores the necessity for interdisciplinary collaboration, as insights from user interface design can inform multimedia education, thereby creating more effective learning materials.

Limitations and Recommendations for Research

This study has several limitations. Firstly, the research sample is restricted to Chinese participants, which may limit the generalizability of the findings across different cultural contexts in education. Since educational narratives often reflect culturally embedded prototypes, the effectiveness and interpretation of anthropomorphic design elements may vary across cultures. In terms of disciplinary focus, this investigation is confined to the subject of geography. Although insights from educators and UI designers offer valuable perspectives on

the application of anthropomorphic graphics, they may not fully capture the potential advantages or limitations of such design approaches in other academic domains.

The results underscore critical tensions and opportunities in the interdisciplinary application of anthropomorphic design. To advance both theoretical understanding and practical implementation, future research should prioritize developing collaborative frameworks to identify the optimal threshold of "moderate anthropomorphism," ensuring alignment with learners' cognitive capacities. Systematic integration of instructional objectives with UI design principles—such as visual hierarchy and metaphor mapping—should be translated into effective guidelines for anthropomorphic design within educational interfaces. Furthermore, exploring educators' and UI designers' perspectives on anthropomorphic graphics across diverse cultural backgrounds will help validate and extend these findings. Given the variability in educational content across disciplines, interdisciplinary investigations should be conducted to provide a comprehensive understanding of the efficacy of anthropomorphic graphics as cognitive tools. Such research will enhance the applicability of anthropomorphic design strategies within the global educational landscape.

Disclosure Statement

- **Ethical approval and consent to participate:** Yes, if needed.
- **Data Availability Statement:** Yes, if needed.
- **Author Contributions:** Liu Jinya designed and conducted the study and drafted the manuscript. Mageswaran

Sanmugam provided constructive feedback and assisted with the final proofreading and revision of the manuscript. Zhao Xin reviewed the designer interview data for accuracy and relevance. Cao Ning reviewed the geographic interview data for accuracy and relevance. Eko Risdianto provided additional constructive feedback on the manuscript.

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