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Reading Images for Knowledge Building: Analyzing Infographics in School Science: A Book Review

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Reading images for knowledge building: Analyzing infographics in school science, Written by J.R. Martin and Len Unsworth, New York: ROUTLEDGE, 2024, 304 pp., (Print Book), ISBN: 9780367759216

ABSTRACT

The book "Reading Images for Knowledge Building: Analyzing Infographics in School Science" by J. R. Martin and Len Unsworth, published by Routledge in 2024, explores new perspectives on visual grammar derived from Systemic Functional Linguistics and their application in the multimodal discourse of school science. It examines key components of infographics, specifically image mass (technicality, iconization, aggregation) and image presence (explicitness, affiliation, congruence). The book enriches our theoretical understanding of visual grammar and provides strategies for the effective use of infographics in classrooms.

KEYWORDS

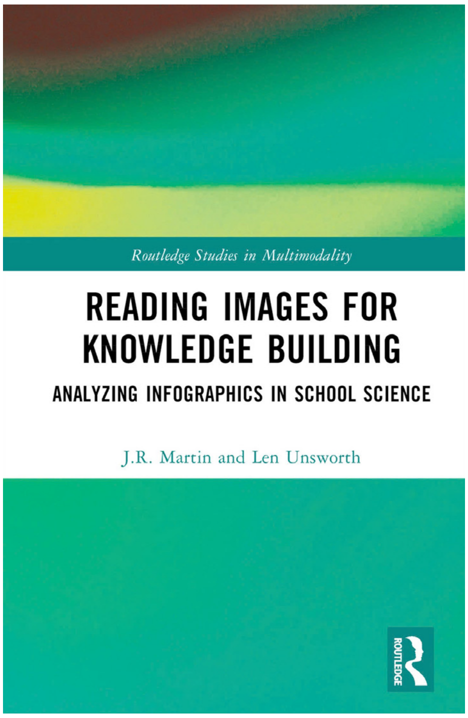
infographics, school science, image mass, image presence, visual grammar, book review

INTRODUCTION

"Reading Images for Knowledge Building: Analyzing Infographics in School Science" is divided into four main parts. Part I revisits Kress and van Leeuwen's foundational concepts, emphasising the need for framework refinement to address issues concerning technical images, and highlighting the importance of captions, annotations and text blocks. Part II examines technicality, iconization, and aggregation - components of image mass. Part III discusses image presence, including visual explicitness, affiliation and congruence. Part IV combines mass and presence for infographic selection and structuring to enhance knowledge-building in junior and senior high school science education.

Part I: Disciplinary Discourse for Knowledge Building

In the introductory chapter and Part I, the authors revisit the foundational knowledge related to visual grammar (VG) developed by Kress and van Leeuwen in Reading Images: The Grammar of Visual



Design across four editions (1990, 1996, 2006, 2021), particularly pointing out the difficulties in interpretation challenges students may face with scientific images in terms of technicality and abstraction using the framework of Kress and van

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Leeuwen (2021). They also emphasise the hitherto neglected but crucial role of captions, annotations, and text blocks that are incorporated within science images in complementing the visual portrayals to represent science concepts (Martin, 2020; Unsworth et al., 2022). As well as dealing with systemic functional descriptions of the meaning-making resources of scientific images, Martin and Unsworth draw on studies that have applied and adapted those descriptions in science pedagogy (Tang, 2020; Tang et al., 2019). They include sections illustrating how the frameworks they propose can be applied in science teaching. This book provides a disciplinary approach across science subjects, revealing the limitations of VG in previous editions.

Part II: Image Complexity – Mass

Building on the foundational concepts, Part II of the book introduces one of the two major aspects of image, *mass*, or image complexity, explored through various dimensions, including *technicality*, *iconization* and *aggregation*. These aspects of mass deal respectively with the ways that ideational, interpersonal and textual meanings are distilled in the semantically dense portrayal of information in infographics.

Part II consists of three chapters, beginning with the exploration of *technicality*, employed to describe the meaning-making resources (image and language) that represent field – a collection of activities that shape our life experiences consisting of the activities themselves and their relevant entities (Doran & Martin, 2021; Martin, 1992, 2020). The book examines the construal of field in terms of: (i) activity (whether it is unfolding over time or not unfolding (i.e. represented as a single action); (ii) classification (types and subtypes) of entities; (iii) composition (whole and part relations) and (iv) property (qualities of entities and activities and their spatio-temporal locations). With the construal of activity and composition, the authors first present its imagic construal, and then continue with annotation, or how language is presented in infographics. However, the structure of the sections on classification and property is different, i.e. images and language are not explored separately; instead, they are intertwined. It is also notable that each aspect of field construal (i.e. activity, classification, composition and property) has its own framework and each framework is summarised as a single figure, making it easier for readers to navigate the available options as they progress through the chapter.

Although the frameworks are conceptually useful, the text stops short of discussing which options are most commonly used, in what contexts and suitable for which levels of learners, or what the advantages and limitations of each option are. In addition, while this section offers a rich typology of imagic construals, it leans heavily on descriptive exemplification. Its explanatory power would be strengthened by a more sustained reflection on the significance of these distinctions for teaching and learning, and their practical implications for educators and textbook designers.

Chapter 4 introduces the term *iconization*, characterised by Martin (2020) as a process that highlights the social values of an event or entity, or its axiological meaning. The framework for analysing the social-semiotic construction of bonding icons (bondicons) is based on the works of Tann (2010, 2013) and Zappavinga and Martin (2018). As stated by the authors, although the original model developed by Tann comprises Gemeinschaft, Doxa and Oracle, only Oracle, a concept referring to famous people and things as bondicons, is relevant in school science discourse. In addition, while the adapted framework features both icons and texts, the discussion of bondicons in this book focuses solely on icons, with subcategories of guru (for famous scientists) and objects (images of animals, plants, artefacts or abstract symbols). Examples of bondicons include the nuclear radiation warning symbol, the DNA double helix or dead animals due to plastic bags. The authors show how students experience bondicons through ways in which such images are represented in textbooks and are established as bondicons. There are different kinds of bondicons aligning groups of students in various ways, namely those oriented to the celebrations of science figures and discoveries, calls for action, and aiming to influence public opinion. The chapter concludes with suggestions for the application of the concept of iconization in science teaching, helping students critically engage with the values embedded in scientific imagery and understand how these visuals shape their alignment with particular scientific perspectives.

However, the strength of this semiotic approach also raises questions about how readily students identify with or critically engage with these bondicons, particularly when their prior experiences or cultural affiliations diverge from those assumed by textbook authors. While the taxonomy of bondicons is conceptually robust, its pedagogical uptake would benefit from more explicit guidance on how teachers might navigate the varying interpretations or resistances that these images could evoke.

Chapter 5, deals with the ways two or more of the aspects of field representation (activity, composition, classification and property) are combined in infographics in a process referred to as *aggregation*. The chapter begins with the introduction of macro- and micro-groupings, with macro-groupings focusing on the layout of the global elements of the infographic (which may be accompanied by co-text), while micro-groupings characterise the relations between component images and verbiage. The chapter then moves on to connect these types of groupings to the frameworks developed in Chapter 3, leading to the formation of a system of aggregation involving two distinct approaches *[accumulation]* across macro-groups and *[integration]* within one macro-group. The authors consequently use this system to observe four textbook representations of global warming. This chapter also concludes with an outline of suggested pedagogical applications, emphasising the need for explicit attention to infographics as an integral part of science pedagogy.

What stands out in this chapter is its reconceptualisation of aggregation, not as a mere technical layout, but as a semiotic and pedagogical issue with real implications for meaning-making in science education. The authors offer a systematic model for analysing infographics and prompt us to rethink how knowledge is hierarchized and accessed. The repeated inconsistencies and omissions in the textbook examples highlight the need for science educators to act as both interpreters and designers of visual meaning. This calls for a pedagogical shift in which infographics should be seen not just as illustrations, but as complex meaning-making tools that students must learn to analyse and construct.

Part III: Image Recognizability – Presence

Shifting from semantic density in Part II to perceptual accessibility – the second key dimension of image analysis – Part III of the book offers a compelling exploration of how images and infographics can be designed and utilised to convey scientific concepts in a manner that is not only accessible but readily understandable for students. The key dimensions of this "recognizability" (or *presence* in the authors' terms) are *explicitness*, *affiliation* and *congruence* – three pillars that underpin the accessibility of visual representations for students (Martin & Unsworth, 2024, p. 140).

Explicitness refers to the nature and extent of clarity and precision in depicting scientific phenomena and their contexts. The main aspects of explicitness are *completeness, environment* and *discernibility*. *Completeness* concerns whether the representation of a phenomenon is truncated either by being cut off, such as an image of just the top of the barrel of a Bunsen burner to show the flame features, or cropped, such as the image of a bicycle wheel showing only the section with the gears. *Environment* concerns whether the background or context of a phenomenon is depicted and to what extent, such as an isolated image of the kidney function without any contextual depiction of the renal system. *Discernability* concerns clarity and precision of depiction. In the context of explicitness, the authors illustrate how explicit imagery significantly aids in deepening student understanding (e.g. Chidrawi et al., 2013; Zedalis et al., 2018). This facilitates a direct and clear transmission of information, where each infographic or image acts as a precise visual explanation that complements and reinforces textual content.

Affiliation underscores the significance of engaging students through relatable and appealing content depiction. The authors explore how the physical and visual characteristics of infographics, such as colour, layout, and iconography, can dramatically influence the learner's engagement and understanding (e.g. Kinnear & Martin, 2021a; Kinnear & Martin, 2021b). They also discuss affiliation in terms of infotainment, provided principally by the inclusion of cartoons in science texts. Some such cartoons prompt or challenge students to extend their understanding of science concepts, while others simply add relevant or sometimes, unrelated whimsical elements to concept portrayal (e.g. William & Gaton, 2013; Kinnear, 2017; Lofts, 2015). By making content more "alive" and present to the viewer, educational materials can foster a deeper connection with the subject matter, thereby facilitating a more intuitive and impactful learning experience. Through practical examples, Martin and Unsworth illustrate how these principles can be effectively applied in the science curriculum, aiming to equip educators and content creators with the knowledge to design infographics that not only convey information accurately but are also easily interpreted by students.

Congruence concerns the extent to which the representation of phenomena aligns with their perceptual reality. Images range from realistic to highly abstract. While naturalistic images are important for relating target concepts to students' lived realities, reduced congruence is frequently required to clearly represent the essential features of the phenomenon being studied. The authors identify and illustrate parameters along which congruence varies. These include colour and two- or three-dimensional perspective as well as factors such as *essentialization*, *vision*, *proportionality*, *reconfiguration* and *genesis*. *Essentialization* refers to strategic deletion from the representation of elements of the phenomenon considered peripheral to the particular pedagogic focus, which for example, results in highly simplified depictions of cells. *Vision* can refer to magnification or other means of depicting internal components that are not normally visible, such as x-ray or cross-sections. Sometimes the proportion dimensions of phenomena are distorted in order to show relationships, such images of DNA showing chromosomes as if they were similar in size to the double helix. *Reconfiguration* can occur in images of the functioning of the ear with cochlea "rolled out" (Martin & Unsworth, 2024, p. 189) as a horizontal tube and *genesis* refers to a single image of a plant at various growth stages from seed to fully grown.

Part IV: Applying Image Analyses for Knowledge Representation

In Part IV of the book, the authors consider both the elements of image complexity (mass) from Part II and recognizability (presence) from Part III when selecting and ordering infographics to enhance knowledge-building in junior and senior high school science. This gives rise to the question: When is it suitable to use a straightforward, visually appealing infographic, and when does the complexity of the subject matter necessitate an infographic with less visually congruent elements to facilitate deeper understanding?

The analysis of selected infographics about the greenhouse effect in junior and senior high school textbooks informs the discussion of how to balance the orientation to mass or presence in using infographics with students at different stages of science learning. Results of the analyses show that in some cases, senior high school infographics are more accessible than those in junior high school texts and could be more suitable for use in junior classes, while in other cases, there are no clear distinctions between images occurring in textbooks at both levels. This surprising reversal calls attention to the common assumption that complexity increases linearly across grade levels and highlights the need for more intentional design and use of visuals.

The authors have also pointed out that the lack of comprehensive curriculum guidance regarding the suitable level of technical detail for junior and senior high school levels, coupled with the inconsistency in textbook infographics across grade levels, places the responsibility of determining an appropriate learning progression for students squarely on teachers. While the chapter does not fully critique the systemic issues behind these vague curriculum statements, it offers practical strategies for navigating this ambiguity. They advise teachers to balance the two elements when choosing infographics, especially in the initial stages of knowledge building, as well as scaffolding students' reading strategies through "deconstructive interpretive practices" (Martin & Unsworth, 2024, p. 214). This involves explicit teaching of the visual communication strategies used for representing the interaction of the various elements of field in order to convey scientific concepts. The suggestion to map meaning across modalities (image, annotation, caption, and text) and to critically examine what is present, omitted or assumed in infographics is particularly valuable, offering teachers a systematic approach to cultivating students' multimodal literacy.

Part IV also examines the interplay of mass and presence in infographics to show how the techniques of multimodal representation vary across the science sub-disciplines, and hence the distinctive multimodal literacies students need in the different subject areas. This part is particularly useful as it offers teachers a thoughtful set of guiding questions related to mass and presence for their own reflection when selecting infographics and for students' critical engagement when interpreting or designing them.

CONCLUSION

Overall, "Reading Images for Knowledge Building: Analyzing Infographics in School Science" by Martin and Unsworth (2024) provides new insights into how language and image resources are deployed in infographics to communicate science concepts. The authors' exploration into how multimodal literacy is interwoven within science education illuminates the process of both creating and interpreting infographics, fostering an enriched learning environment, and facilitating the nurturing of critical thinking and knowledge exploration. The book stands not just as an invaluable resource but also as a call to action for leveraging the substantial potential of infographics for enhancing teaching and learning in school science.

Unlike existing studies that simply analyse science images using VG (e.g., Christidou et al., 2023; Fernández-Fontecha et al., 2018) or testing the effectiveness of infographics in science classes (e.g., Agley et al., 2021; Basco, 2020; Menendez et al., 2024; Scott & Jenkinson, 2020), Martin and Unsworth's work offers a distinct contribution by addressing the unique semiotic nature of scientific infographics and proposing purpose-built tools for both analysing and designing them within science education. Their approach not only bridges disciplinary literacy and multimodal analysis but also foregrounds students' active meaning-making through both interpretation and production of infographics, which is an area less emphasized in prior research.

Although the proposed frameworks are comprehensive and suggest potential for application beyond science, the book does not explicitly explore how scalable or adaptable these tools might be in other disciplinary contexts. Furthermore, while the authors provide numerous prompts and pedagogical suggestions throughout the book to support student interaction with infographics, the absence of empirical classroom evidence, such as classroom-based trials or implementation studies, leaves open questions about the practical feasibility of incorporating such detailed analytical tools in real instructional settings. The addition of small-scale empirical insights would have strengthened the book's applicability in practice. Nonetheless, the clarity and pedagogical orientation of the frameworks make them well-suited for integration into teacher training modules focused on visual literacy and multimodal analysis, as well as direct application in classroom activities such as infographic analysis, visual scaffolding and student-generated infographics. This book serves as a valuable resource for a wide audience, including educators, curriculum designers and linguists who are interested in the intersections of language and imagery in science pedagogy.

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DECLARATION OF COMPETING INTEREST

None declared.

AUTHORS' CONTRIBUTION

Chau Hoang Vo: Conceptualization; Data curation; Formal analysis; Funding acquisition; Methodology; Project administration; Visualization; Writing – original draft; Writing – review & editing.

Tin Thanh Nguyen: Formal analysis; Investigation; Methodology; Resources; Software; Supervision; Writing – original draft.

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