



RESEÑA / REVIEW

Yaegan Doran: *The Discourse of Physics: Building Knowledge Through Language, Mathematics and Image**

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As one of the series of Routledge Studies in Multimodality, *The Discourse of Physics: Building Knowledge Through Language, Mathematics and Image*, written by Dr. Yaegan Doran, extends the scope of multimodality studies to pedagogy and scientific discourse. Physics, characterized as the hardest of the natural sciences, shares many of the features of the natural sciences. Meanwhile, it has unique ways of organizing and expressing its knowledge. The book investigates how physics organize its knowledge through three key semiotic resources and explains why physics maintains its distinctive knowledge structure, based on the examination of the discourse of physics collected from Australian textbooks, classrooms and student work across a broad range of levels. In this way, the author aims to facilitate a better understanding of both the knowledge structure and the discourse of physics, and to offer insights into the development of a discipline-sensitive pedagogy.

The book consists of seven chapters. Chapter 1 briefly introduces the background and the organization of the book. Firstly, two fundamental features of physics, the disciplinary nature of its knowledge and its multi-semiotic nature, are identified. Therefore, to fully understand the discourse of physics, it is essential to interpret the physics as a discipline of specific organization of knowledge and fully comprehend the various semiotic resources involved in the discourse of physics, which consequentially become the two main themes of the whole book. The rest of Chapter 1 lays out the theoretical foundation of the book—*Systemic Functional Linguistics* (hereafter SFL), including some key concepts, such as *stratification*, *metafunction*, *rank*, *nesting* and *axis*.

Chapters 2-6 constitute the main part of the book, progressively unfolding the investigation of the key components of physics. Chapter 2 puts the spotlight specifically on the role of language in physics. It explores the meanings that language organizes in physics in terms of SFL's concept of *field*, a register variable which is concerned with the nature of the social activity (Martin, 1992). The analysis shows that language in physics, with the help of two pervasive linguistic devices known as *technicality* and *grammatical metaphor*, constructs a large set of deep taxonomies of classification and composition, as well as a series of implication or expectancy activity sequences in physics.

After discussing the role of language in physics, the book turns to mathematics, another important component of physics, with the intention to develop a fully systematized grammar of mathematics on its own terms based on the axial perspective. Chapter 3 devotes to establishing the systems and structures required to account for the variation in mathematics. It starts with individual symbols and their complexing relations into expressions and then moves to larger mathematical statements such as equations, focusing especially on how statements link expressions and how meanings are coordinated within larger texts.

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While Chapter 3 focuses on the organization of mathematical statements, the highest level of the grammar, Chapter 4 explores the organization of symbols—the smaller units of mathematics—within expressions to reveal their distinct structures derived from their own systems. Bringing the descriptions of the organization of mathematical statements and symbols together, a broad model of the architecture of mathematics is finally established in Chapter 4. In terms of its hierarchy of levels, the hierarchy of units in mathematics consists of a two-level nesting scale complementing a two-level rank scale, with the level of symbol situated in both, which is different from the constituency-based single rank hierarchy in language. In terms of the metafunctional organization, there are three metafunctional variables in mathematics, including the logical, operational and textual components, without the interpersonal one in language.

Building on the isolated examination of mathematics on a small, grammatical scale in the two previous chapters, Chapter 5 takes the next step by exploring the interaction of mathematics with language from a different angle—*genre*, as there is a constant exchange of meaning between language and mathematics in physics. Chapter 5 firstly builds a generalized stratum of genre jointly realized by language and mathematics, which contributes to explaining how mathematics and language coordinate to achieve higher order meanings through the large-scale patterns of mathematics and language in mathematical texts. Then the focus is shifted to the role of mathematics in the knowledge-building of physics. A survey is conducted to examine how the use of mathematics progress in physics schooling from primary school to university from the perspective of the Semantics dimension of *Legitimation Code Theory* (hereafter LCT) (Maton, 2014). It is shown that mathematics is used as an instrument, which enables physics to expand the frontiers of knowledge through building relatively abstract and condensed models of its object of study, and to link theory to the empirical world at the same time.

While Chapter 5 conducts a bimodal discussion of language and mathematics, Chapter 6 moves to a tri-modal one by bringing images in alongside language and mathematics. It examines each resource in relation to the field of physics in terms of the LCT variables of *semantic gravity* (the degree of dependence of meaning on their context) and *semantic density* (the degree of condensation of meaning in an item). The examination shows that the knowledge of physics undergoes *condensation* (strengthening semantic density), *gravitation* (strengthening semantic gravity) and *levitation* (weakening semantic gravity) through the interplay of language, images and mathematics. The interactions among the three semiotic resources in physics not only broaden the horizons of knowledge but also keep the knowledge in touch with the physical world. The unveiled ability of the discourse of physics to develop semantic density and shift semantic gravity is a typical feature of the hierarchical knowledge structure. Therefore, physics is characterized as a hierarchical knowledge structure, attempting to “create very general propositions and theories, which integrate knowledge at lower levels and in this way show underlying uniformities across an expanding range of apparently different phenomena” (Bernstein, 1999: 162).

Chapter 7, as the final chapter, brings together the themes discussed in the previous chapters and considers some of the broader ramifications of this study. It starts with an overview of the disciplinary affordances of language, image and mathematics in relation to the field of physics, then it moves to a reflection on the broader semiotic descriptive issues emerging from the book. Finally, some broader implications are listed, which are mainly concerned with a more comprehensive understanding of physics and the development of a broader semiotic typology.

Overall, the book is an innovative investigation of the structuring principles of physics knowledge in terms of the language and other resources used in physics. It explores the multimodal nature of physics based on an SFL approach and provides a model of the knowledge structure of physics within the sociological framework of LCT. In a word, it interprets physics knowledge semiotically.

Two striking features of the book are particularly worth mentioning. Firstly, the book overcomes the ‘knowledge-blindness’ (Maton, 2014) in current educational practices and research, which ignores the principles underpinning the various educational and literacy practices of disciplines. The exploration of the knowledge structure of physics and the role of the semiotic resources in physics offers insights into understanding how physics works in its own specific way and the special position of physics within the academic world, which underscores the importance of a discipline-sensitive pedagogy.

Secondly, the book avoids the linguistic imperialism prevailed in previous descriptions of semiotic resources since Kress and van Leeuwen (1990), which generally assumed that all the semiotics were of the same metafunctional organization as that of language. Instead of assuming, it tests macro-theoretical categories such as metafunction, strata and rank across semiosis and describes different semiotic resources on their own terms, based on the axial perspective. The result of the description reveals that the organizations of mathematics and language are significantly different in terms of their level hierarchies and metafunctional organizations.

On the whole, the book is a valuable contribution to both pedagogical and semiotic studies, providing a comprehensive understanding of physics in particular, and academic knowledge in general. It is therefore an insightful resource and an excellent guide for both students and researchers in discourse analysis, educational linguistics, multimodality, and science education.

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