# Reflections on Pre-service English Teachers' Interpretation of Popular Science Texts through the Lenses of the Response-Inviting Structure and the Fusion of Horizons

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**Abstract:** Drawing on Iser's concept of the response-inviting structure and Gadamer's fusion of horizons, this study examines pre-service English teachers' interpretation of popular science texts using 25 instructional designs for the same text. The findings indicate that, although the participants could identify the text's surface structure, they overlooked, to varying degrees, three types of cognitive invitations: gaps in underlying principles, gaps in evidential hierarchy, and structural gaps. Their interdisciplinary extensions contained some conceptual inaccuracies, their construction of thematic meaning remained superficial, and approximately half adopted an information-retrieval orientation. The central difficulty was their failure to recognize the pedagogical value of information left unstated in the text. On this basis, the study proposes improvements to the development of text analysis competence in pre-service English teacher education.

***Keywords*:** pre-service English teachers; popular science expository texts; text interpretation; textual gaps; response-inviting structure; fusion of horizons

## 1. Introduction

The English Curriculum Standards for General Senior High Schools explicitly require teachers to "study texts in depth, grasp thematic meaning[1]." Wang Qiang et al. (2019: 40) argue that teachers' text interpretation competence directly affects "the extent of students' learning experiences, the dimensions of their cognitive development, the depth of their emotional engagement, and the level of their learning outcomes [2]." Jiang Jingli (2022: 27) contends that teachers' insufficiently thorough and systematic study of teaching materials results in instructional designs that constrain the development of students' core competencies. Teachers' text interpretation competence therefore warrants close attention [3].

Popular science expository texts have become a major source of reading passages in the English component of the National College Entrance Examination. The 2026 examination papers "closely engage with the frontiers of scientific inquiry and technological innovation, guiding students to sharpen their analytical and inquiry skills and promoting the scientific spirit [4]". Existing research has largely focused on strategies for teaching popular science reading and the development of students' scientific literacy. By contrast, research on text interpretation for teaching "remains at an initial stage [2]", concentrates mainly on literary and argumentative texts, and generally "adopts frameworks derived from text linguistics or extended cognition [5]". This study introduces Iser's concept of the response-inviting structure and Gadamer's fusion of horizons to examine pre-service English teachers' interpretation of popular science texts through the widely neglected dimension of information left unstated in a text.

## 2. Perspectives from Reception Aesthetics and Philosophical Hermeneutics

### 2.1 Iser's Response-Inviting Structure: From Aesthetic Blanks to Cognitive Gaps

Iser, as a leading figure in reception aesthetics, argues that a literary text is not a finished product with self-sufficient meaning, but a structure of potential meaning constituted by blanks, vacancies, and negation. Blanks are spaces of meaning left between textual signs that invite readers to complete interrupted connections; vacancies are a higher-order form of blanks, arising from discontinuities in the textual configuration as the reader's perspective shifts; and negation disrupts readers' existing expectations, prompting them to develop new interpretive frameworks. Together, these elements invite readers to participate in meaning-making, while the textual structure also constrains the boundaries of their re-creation [6].

Sullivan (2006) [7] and Qi Yawei et al. (2026) [8], among others, maintain that popular science texts combine scientific and literary qualities with accessibility and reader appeal. Zhu Liyuan (1988) [9] argues that the thought-provoking quality of such texts resides not in blanks or negation, but in the intellectual value of their claims and exposition, including their

content, methods, lines of reasoning, and logic. As translations of scientific content for a general audience, popular science texts necessarily simplify technical derivations and omit details of underlying principles to ensure readability. These omissions give rise to a distinctive type of cognitive gap: what they invite is not aesthetic imagination, but cognitive inference constrained by scientific logic.

In relation to the text examined here, gaps in popular science texts can be classified into three types: gaps in underlying principles, where a core technological mechanism is named but not explained; gaps in evidential hierarchy, where differences in the strength of evidence are not made explicit; and structural gaps, where information implicit in the allocation of space and the arrangement of content remains unstated.

### 2.2 Gadamer's Fusion of Horizons: From Information Reception to Cognitive Reconstruction

The fusion of horizons is a central concept in Gadamer's philosophical hermeneutics. He maintains that interpreters enter the process of understanding with individual horizons shaped by their prejudgments, while a text embodies a horizon situated in a particular historical context. Understanding does not require readers to abandon their own horizons in order to reproduce the text's original meaning. Rather, it is a dynamic process in which the two horizons mutually revise and interpenetrate one another through dialogue, generating a new horizon. This process is conditioned by the "history of effects": both the reader's and the text's horizons are products of history, and purely objective understanding detached from history is impossible (Gadamer, 2010) [10].

Popular science texts are themselves products of dialogue between scientists' specialized horizons and the everyday horizons of the general public. In educational settings, genuine understanding of a popular science text involves more than reproducing its surface content: it entails a structural reorganization of the reader's existing cognitive framework through dialogue with the text. This view is consistent with the new curriculum standards' central requirement to explore thematic meaning.

Accordingly, the fusion of horizons is operationalized at three levels: the informational level, involving the identification of explicit information; the intentional level, involving awareness of authorial purpose and rhetorical strategies; and the reconstructive level, at which existing understandings substantively engage with the text's horizon and the reader's cognitive structure is renewed.

### 2.3 An Integrated Dual-Theory Framework

The response-inviting structure focuses on the text, revealing the space of possibilities for meaning-making; the fusion of horizons focuses on the reader, describing the process and depth of gap-filling. Together, they constitute an integrated interpretive mechanism of "textual invitation–reader response." Each instance of interpretation in this study is analyzed along two dimensions: whether a particular type of gap is identified, and the cognitive level at which that gap is addressed.

## 3. Research Design

### 3.1 Participants and Data Sources

The participants were 25 third-year students majoring in English teacher education at a provincially administered normal university. They had completed the core courses in subject-specific pedagogy, but their program did not include a dedicated module on popular science texts. They thus offered a reasonably representative picture of competence under a conventional training model. The text, More Bioengineering Experiments to Save the World, was assigned in the preliminary round of a provincial teaching skills competition for pre-service teachers, and comprises an introduction and two sections on wastewater treatment and cancer treatment with the central claim that microorganisms can be engineered to serve as a basis for industrial production. The data comprised independently completed instructional designs for the same text, each including a lesson plan, presentation slides, and a 12-minute teaching video. Lesson plans served as the primary analytical material, with slides and videos used for corroboration. If an interpretive feature was absent from the lesson plan but clearly present in the slides or video, it was coded as "identified"; if it appeared in none of the three sources, it was coded as "not addressed."

### 3.2 Analytical Method

Qualitative content analysis was employed. The coding framework was developed through a combination of theory-driven and text-driven procedures: the three types of gaps provided the initial categories, and a close reading of all instructional designs yielded descriptions of specific practices that informed the final coding scheme. The unit of coding was an individually identifiable instructional decision or activity design. Five dimensions were coded: identification of text structure, treatment of argumentative logic, understanding of core principles, interdisciplinary extension, and construction

of thematic meaning. Two researchers first piloted the coding on three lesson plans, discussed and revised the scheme, and then independently coded the full dataset. Inter-coder agreement was 92.2%, and disagreements were resolved through discussion.

# 4. Findings

## 4.1 Identification of Text Structure: Topic Segmentation Displaces Attention to Structural Gaps

All 25 instructional designs accurately identified the two subtopics, and 19 (76.0%) attempted to organize information using structured knowledge maps. However, the frameworks were labeled inconsistently, such as "problem-method-feasibility", "problem-solution-data", "problem-principle-proof", and most designs did not define what their labels meant. As a result, the maps remained formal devices rather than functioning as cognitive tools. Overall, recognition of the predefined structural gaps was limited. Only five designs (20.0%) addressed the multiple meanings of "More" in the title—more experiments, greater depth, or expansion into additional fields—and its rhetorical function, whether informative or exhortative. Of these, only two linked it to the intensifying meaning of "even" in the text; the other 20 treated the title merely as a topic label. Differences in length and evidence density between the two main sections were largely ignored, with only one design asking why the cancer treatment section contained comparatively little information. None identified the absence of a concluding section as a structural feature. The participants generally remained at the informational level and did not engage with the deeper intentions underlying the arrangement of content.

## 4.2 Treatment of Argumentative Logic: Undifferentiated Evidence Obscures Gaps in Evidential Hierarchy

Thirteen designs (52.0%) incorrectly treated nineteenth-century records of cancer regression in patients with erysipelas as experimental evidence, while three (12.0%) misread experimental validation as large-scale industrial application. In fact, the nineteenth-century case records constitute passive naturalistic observations, the desalination experiments constitute empirical research involving active intervention, and large-scale application belongs to the stage of industrial implementation. The three differ fundamentally in evidential strength. Because the text does not explicitly distinguish these levels, it contains a gap in evidential hierarchy that readers must resolve for themselves. Yet half of the participants conflated evidence from different levels. From the perspective of the fusion of horizons, this reflects a naïve prejudgment that "evidence is material that supports a claim," which never substantively engages with the specialized horizon of scientific argumentation. A deeper loss follows: the text's reference to historical records is intended to convey a "history of effects"; interpreting those records as experimental evidence forfeits opportunities both to develop a historical understanding of science and to undertake rhetorical analysis.

## 4.3 Understanding of Core Principles: Systematic Neglect of Gaps in Underlying Principles

Gaps in underlying principles constitute the most important cognitive invitations and the area most widely neglected. Both main sections contain conspicuous gaps of this kind: neither how Geobacter generates electricity nor why Clostridium can target tumors is explained. Only four designs (16.0%) posed questions about these core principles. Nineteen (76.0%) used a framework such as "Problem → Method → Result," and six of these entered bacterial names directly in the "Method" column, producing a logical sequence of "problem → bacteria → result." Bacteria thereby became a cognitive black box requiring no explanation. What students learned was thus the substitution of labels rather than scientific reasoning. The vast majority of participants treated textual gaps as obstacles to circumvent rather than as pedagogical resources, remaining at the informational level of interpretation.

## 4.4 Interdisciplinary Extension: Conceptual Misunderstandings within Limited Knowledge Horizons

Seventeen designs (68.0%) proactively supplied additional examples involving microorganisms, indicating an awareness of the need to extend learning beyond the text. However, eight (32.0%) contained conceptual inaccuracies: classifying yeast as bacteria, attributing artemisinin to microbial engineering, or describing bacteria as "scientists' inventions." The third misconception reflects a distorted view of science, implying that bacteria are human creations rather than organisms that long predate humans through natural evolution. This finding accords with Xu's research[11] identifying weaknesses in English teachers' scientific literacy. From the perspective of the fusion of horizons, this anxiety-driven importation of material stems from a knowledge horizon insufficient to sustain deep dialogue with the scientific horizon of the text. Participants recognized that gaps existed but lacked the resources to fill them accurately; instead, they inserted peripheral material that introduced

further inaccuracies.

### 4.5 Construction of Thematic Meaning: A Dual Disconnect in Linguistic Analysis and Cognitive Integration

The linguistic dimension revealed a division between the identification of technical features and the development of meaning: 12 designs (48.0%) identified numerical data and examples and incorporated corresponding activities, but none of the three designs that mentioned "persuasive techniques" provided accompanying language inquiry activities. Recognition of rhetoric thus remained at the level of labeling.

The discontinuity across levels of thematic understanding was even more pronounced. Twenty-three designs (92.0%) included terms such as "authorial intention," but 14 of these provided no corresponding inquiry activities and merely attached labels, effectively remaining at the informational level. Six partially reached the intentional level, and only three reached the reconstructive level, recognizing that the text sought to challenge the default assumption that industrial production depends on petroleum and mineral resources. Overall, approximately half of the participants constructed thematic meaning at the informational level, reducing it to "introducing applications of bioengineering" and overlooking the text's deeper educational value.

## 5. Conclusions and Recommendations

### 5.1 Conclusions

Drawing on the response-inviting structure and the fusion of horizons, this study systematically examined pre-service English teachers' interpretation of popular science texts through 25 instructional designs for the same text. The findings indicate varying degrees of neglect across all three types of cognitive invitations, some conceptual inaccuracies in interdisciplinary extension, and an informational level of thematic meaning construction in 56.0% of the designs. Overall, approximately half displayed an information-retrieval orientation. The central difficulty lies in treating popular science texts as "containers of facts" and failing to recognize the pedagogical value of unstated information. By extending theories of textual gaps and the response-inviting structure to the analysis of popular science texts, this study proposes a taxonomy of cognitive gaps and an interpretive approach organized around "textual invitation–reader response." It thereby offers a new analytical perspective for reforming text analysis courses in English teacher education.

### 5.2 Recommendations for Teacher Education

First, broaden the cognitive perspectives used in text analysis. Incorporate textual gaps and the response-inviting structure into text analysis courses, introduce dedicated training in the close reading of popular science texts, and use a gap-identification checklist to guide pre-service teachers in systematically annotating unstated information and considering how it can inform instruction. Second, introduce training in interdisciplinary reading strategies. The aim should be to develop metacognitive capacities for rapidly identifying core concepts, appropriately verifying specialized content, and detecting logical gaps, rather than requiring systematic mastery of the natural sciences; this can help alleviate anxiety about interdisciplinary knowledge. Third, strengthen the connection between interpretation and instructional design. Require lesson plans to be linked to records of text analysis, with the interpretive basis of each teaching activity explicitly identified. This requirement can foster the professional habit of undertaking in-depth interpretation before designing instruction.

### 5.3 Limitations

The sample was drawn from a single institution, so the generalizability of the findings requires further examination. Moreover, the analysis focused primarily on completed instructional designs and did not capture the thinking processes underlying interpretation. Future research could incorporate process-oriented data, such as think-aloud protocols and interviews, to investigate the cognitive mechanisms of text interpretation more closely.

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