Unveiling the Pedagogical Paradox: A Quality Assessment of Explanatory Notes and Cognitive Demands in Singapore Primary Science Assessment Books

Wai Mun Loke[1]
[1] Nanyang Polytechnic Singapore
wai.mun.loke@innovprof.com

Abstract

Empirical research on the quality and pedagogical effectiveness of Singaporean primary science assessment books is scarce despite their widespread use. This study aimed to evaluate their explanatory notes and assessment items. Twenty-six commercially available Primary Four Science assessment books (Singapore Ministry of Education syllabus-aligned, 2021-2025) were analyzed. Trained personnel assessed explanatory components for type, location, proportion, and quality (35-point rubric). Questions were evaluated for type, proportion, cognitive demand (Bloom's Taxonomy), science process skills, clarity, language, and context. Only 53.8% of books had explanatory notes (mean 32% of pages), universally in answer sections. Mean note quality was 62.9%, with ‘completeness’ and ‘examples’ scoring lowest. Questions formed 73.6% of pages, primarily multiple-choice and open-ended structured. All books addressed Bloom's Taxonomy up to ‘evaluating’ but omitted ‘creating’. Science process skill ‘Formulating a hypothesis’ was also universally absent. Question language was clear, but contexts lacked Singapore-specific scenarios. These assessment books largely function for practice and summative testing, often with inadequate or poorly placed explanations. A universal cognitive ceiling exists, failing to foster higher-order skills like ‘creating’ or ‘formulating hypotheses’. This indicates a market prioritizing question volume and standardized assessment, leading to pedagogically limited resources.

Keywords

Science assessment book | explanatory note quality | assessment question quality
cognitive demand | science process skills | pedagogical effectiveness

Introduction

Assessment books are a ubiquitous supplementary resource within the Singaporean education system, widely utilized across primary, secondary, and tertiary levels to support learning and evaluation (Ho & Lee, 2022). These commercially published compilations of exercises and questions are designed to align with the national curriculum, as prescribed by the Ministry of Education (MOE). Different types of assessment books serve distinct purposes (Leong & Tan, 2014). Topical practice books offer focused exercises aligned with specific syllabus content areas, facilitating reinforcement and mastery of individual concepts (Leong & Tan, 2014). Year-end or examination practice books often simulate the format and rigor of national examinations, such as the Primary School Leaving Examination (PSLE), serving as crucial preparation tools (Leong & Tan, 2014). Furthermore, some resources incorporate step-by-step solution guides and diagnostic quizzes to aid self-assessment and the identification of learning gaps (Leong & Tan, 2014). The utilization of these books in

Singapore aims to support students' independent learning and revision, provide teachers with supplementary practice materials and formative assessment opportunities, and enable parents to actively engage in their children's academic development (Leong & Tan, 2014). Given the significant reliance on these resources, evaluating their quality and alignment with pedagogical goals within the Singaporean context is paramount.

Despite the widespread use of commercial science assessment books in Singaporean primary education, there is a paucity of empirical research rigorously evaluating the quality of their constituent components. Specifically, the extent to which the explanatory notes effectively clarify scientific concepts and address potential student misconceptions remains largely unexamined. Similarly, the cognitive demand, alignment with curriculum learning objectives (beyond topic matching), and the capacity of the assessment items to elicit and evaluate a range of scientific understanding and process skills have not been extensively investigated through systematic studies. This lack of empirical data hinders a comprehensive understanding of the pedagogical effectiveness and potential limitations of these widely adopted learning resources.

This study aimed to evaluate the characteristics and quality of explanatory annotations and assessment items within commercially available science assessment books intended for Singapore primary education.

Materials and methods

Study design
The assessment books included in this study were selected based on the following criteria: (1) publication in English, which is the primary language of instruction in Singapore's education system; (2) strict alignment with the current Primary Four Science syllabus as outlined by the Ministry of Education (MOE) (Ministry of Education, Singapore, 2022); (3) publication by companies operating within the Singaporean market, including local publishing houses and Singaporean branches of international publishing companies; and (4) commercial availability in hardcopy format in major Singaporean bookstores or through publisher e-commerce sites at the time of the study.

Explanatory component characteristics & quality assessment
Trained personnel recorded the characteristics (types, locations, and quantity) of the explanatory components. Explanatory notes were categorized as one of the following types: concept summaries/overviews, definitions, worked examples, annotated diagrams/ illustrations, key points/ notes, or concept maps/ flow charts/ tables. An assessment book could contain zero or multiple types of explanatory components. Explanatory components were located at the beginning of chapters, within dedicated sections, or in the answer keys. The prevalence of various types of explanatory notes and their locations in the assessment books was assessed. The quantity of explanatory components in each assessment book was quantified as a percentage of the total number of pages. The overall quality of explanatory notes in each assessment book was evaluated using a semi-quantitative rubric comprising seven criteria (Table 1). Each criterion had a maximum score of 5, contributing to a maximum possible total score of 35. The ‘Accuracy of Contents’ assessment evaluates the degree to which scientific information is presented with precision, reliability, and freedom from errors. This assessment is crucial in ensuring that the information being conveyed is trustworthy, up-to-date, and accurate. The ‘Completeness of Explanation’ assessment

evaluates the extent to which an explanation or response provides a comprehensive and insightful understanding of a concept, idea, or reasoning. This assessment aims to determine whether the explanation is thorough, well-articulated, and effectively addresses potential misconceptions or areas of confusion. The 'Clarity and Simplicity of Language' assessment evaluates the effectiveness of language use in communicating scientific concepts and information to the target student audience. This assessment aims to determine whether the language used is clear, concise, and accessible, facilitating easy understanding and comprehension. The 'Logical Flow and Structure' assessment evaluates the organization and coherence of explanatory notes, determining whether the scientific concepts are presented in a clear, logical, and easy-to-follow manner. This assessment aims to ensure that the notes are well-structured, making it simple for readers to understand and follow the explanation. The 'Use of Examples/Analogies' assessment evaluates the effectiveness of examples or analogies used to illustrate complex scientific concepts or principles. This assessment aims to determine whether the examples or analogies used are relevant, insightful, and effective in enhancing understanding and promoting deeper learning. The 'Addressing the "Why" and "How"' assessment evaluates the quality and depth of explanations provided for a particular scientific concept. This assessment aims to determine whether the explanation not only provides a clear understanding of the correct concept but also offers insight into the underlying reasoning, logic, and principles. The 'Formatting and Presentation' assessment evaluates the visual organization and layout of content, determining whether the use of formatting elements such as headings, bullets, bold text, and diagrams enhances readability, highlights key information, and promotes engagement.

Table 1: Semi-quantitative rubric for assessing the quality of the explanatory notes in the selected assessment books (n=26)

Criterion	*5 - Excellent*	*4 - Very Good*	*3 - Good*	*2 - Fair*	*1 - Needs Improvement*
Accuracy of Content	All scientific information is highly accurate, current, and entirely free of errors. Concepts are explained with perfect precision.	Scientific information is very accurate and current, with only negligible, non-misleading errors. Concepts are explained correctly.	Scientific information is mostly accurate, with only minor, non-misleading inaccuracies. Concepts are generally explained correctly.	Contains some inaccuracies or outdated information that could potentially mislead the learner. Concepts may be partially incorrect.	Contains significant inaccuracies or outdated information that fundamentally misrepresents scientific concepts.
Completeness of Explanation	Provides a remarkably thorough and insightful explanation that fully addresses the concept or	Provides a very complete explanation, covering all essential aspects. Effectively anticipates and	Provides a mostly complete explanation, covering the main points. May lack minor details	Explanation is incomplete, missing key steps, reasoning, or relevant information needed for	Explanation is significantly incomplete or superficial, failing to explain the concept or

	reasoning. Exceptionally well-anticipates and clarifies potential student misconceptions.	addresses most potential student misconceptions.	or not fully anticipate all misconceptions.	full understanding. Does not address misconceptions.	reasoning adequately.
Clarity and Simplicity of Language	Uses exceptionally clear, concise, and perfectly appropriate language for the target audience. Effortlessly avoids jargon or complex structures.	Uses very clear and concise language, highly appropriate for the target audience. Jargon is minimal or well-explained.	Uses generally clear language, though there may be occasional jargon or slightly complex sentences that are still understandable with effort.	Language is often unclear, uses excessive jargon without explanation, or employs overly complex sentence structures that hinder comprehension.	Language is consistently confusing, overly technical, or poorly written, making the explanation difficult or impossible to understand.
Logical Flow and Structure	The explanation is perfectly organized with a seamless and logical progression of ideas. Transition words are used expertly. Extremely easy to follow.	The explanation is very well-organized with a clear and logical flow. Transition words are used effectively. Very easy to follow the reasoning.	The explanation is reasonably well-organized, but the flow could be slightly improved. Most readers can follow the reasoning without significant difficulty.	The explanation lacks clear organization and logical flow. Ideas jump around, making it difficult to follow the reasoning or connect concepts.	The explanation is disorganized and disjointed, making it extremely difficult or impossible to follow the reasoning or understand the intended message.
Use of Examples/Analogies (if applicable)	Uses exceptionally relevant, insightful, and highly effective examples or analogies that profoundly	Uses very relevant and effective examples or analogies that significantly aid understanding of abstract	Uses relevant examples or analogies that are somewhat helpful in clarifying concepts.	Examples or analogies are either irrelevant, confusing, or absent where they would be beneficial.	Examples or analogies are misleading, incorrect, or their absence severely impacts the clarity of the explanation.

	enhance understanding of abstract concepts.	concepts.			
Addressing the "Why" and "How"	Provides a comprehensive and insightful explanation of why the correct answer is correct, how to arrive at it, and completely clarifies why incorrect options are wrong.	Clearly explains why the correct answer is correct and how to arrive at it, and effectively addresses why incorrect options are wrong.	Explains why the correct answer is correct and how to some extent, but may not fully elaborate on why incorrect options are wrong.	Partially explains why the correct answer is correct but lacks sufficient detail on how or fails to address incorrect options effectively.	Fails to adequately explain why the correct answer is correct or how to reach it. Does not address incorrect options.
Formatting and Presentation	Employs outstanding use of formatting (headings, bullets, bold text, diagrams) to maximize readability and highlight key information. Presentation is exceptionally clean and inviting.	Uses formatting very effectively (headings, bullets, bold text, diagrams) to enhance readability and highlight key information. Presentation is very clean and easy to read.	Uses some formatting elements that are helpful, though consistency or effectiveness could be improved. Presentation is generally readable.	Formatting is inconsistent or poorly used, which may make the explanation harder to read or understand. Presentation is cluttered.	Formatting is absent or actively hinders readability and comprehension. Presentation is messy and difficult to navigate.

Question characteristics & quality assessment

Trained personnel recorded the characteristics (types and quantities) of the questions. The quantity of questions was expressed as a percentage of the number of pages with questions over the total number of pages in the assessment book. The questions were categorized into the following types: multiple choice, true-false, and open-ended structured. An assessment book could contain one or more types of questions.

The quality of the questions was evaluated by assessing their cognitive demand, the science process skills they elicited, their clarity, the appropriateness of the language used, and the type and relevance of any contextual information provided. Cognitive demand was categorized according to Bloom's Taxonomy of Cognitive Domains, encompassing the levels of remembering, understanding, applying, analyzing, evaluating, and creating (Bytyqi-Damoni et. al., 2025). The science process skills assessed included observing, comparing, inferring, analyzing, evaluating, and formulating hypotheses (Ministry of Education,

Singapore, 2022). Question clarity was evaluated based on the ease with which the question could be understood by the target audience. The assigned categories represented a gradient of interpretability: 1) Very clear: The question was straightforward, using precise language with no potential for misinterpretation; 2) Clear: The question was generally easy to understand, with minimal potential for confusion; 3) Ambiguous: The question contained elements that could lead to multiple interpretations or a lack of clarity regarding what was being asked; 4) Very ambiguous: The question was significantly unclear, making it difficult to discern the intended meaning or the expected response. This categorization allowed for a qualitative measure of how well each question was formulated in terms of its comprehensibility (Bytyqi-Damoni et. al., 2025). Language was categorized as appropriate when it was deemed suitable for the target age group, characterized by vocabulary within their likely understanding, non-complex sentence structures, and an engaging and relevant tone. Conversely, language was categorized as inappropriate when deemed unsuitable for the target age group, potentially involving overly advanced vocabulary, complex grammatical structures that could impede comprehension, or a tone that was not engaging or relevant for this educational level (Yaman, 2017). The context of each question was categorized as abstract scientific, real-world generic, or Singapore-specific (Deehan et. al., 2022). The relevance of the context was rated as very relevant, relevant, or irrelevant. This categorization and rating were performed to analyze the contextual framing of the questions and their potential influence on student engagement and understanding within the specific educational context of Singapore (Deehan et. al., 2022). The "abstract scientific" category encompassed questions grounded purely in scientific concepts without direct ties to everyday scenarios. ‘Real-world generic’ included contexts familiar in a general sense, while ‘Singapore-specific’ referred to scenarios or examples directly related to the local environment or culture. The relevance rating assessed the degree to which the provided context enhanced the understanding or applicability of the scientific concept being assessed.

Statistical analysis

Statistical analyses were conducted using Microsoft Excel (Version 2408 or later). Differences between the mean of a group and a reference value were statistically evaluated using a one-sample *t*-test. Differences in the means between two groups were statistically determined using two-sample independent *t*-tests. Statistical differences between three or more groups were evaluated using ANOVA with Bonferroni adjustment. Statistical significance is established when p value is less than 0.05.

Results

Assessment book characteristics

A total of twenty-six titles that met the inclusion criteria were incorporated into this study. The publication dates of the included titles ranged from 2021 to 2025. The assessed books had a mean page length of 293 pages (standard deviation = 96 pages). The prices of the books ranged from SGD 11.45 to SGD 18.70, with a mean price of SGD 15.21 (standard deviation = SGD 2.25).

Explanatory component characteristics & quality assessment

A total of 53.8% of the evaluated assessment books incorporated explanatory notes. The proportion of book pages dedicated to explanatory notes ranged from 5% to 77.3%, with a mean of 32% and a standard deviation of 26%. The most prevalent form of explanatory notes in the assessed books was ‘concept summaries and overviews’, which were featured in 46.2%

of the titles. Annotated diagrams/ figures/ illustrations, definitions, and worked examples were also commonly observed, each appearing in 38.5% of the assessed books. In comparison to the aforementioned categories, concept maps/ flowcharts/ tables (26.7%), introductory text (30.8%, and key points/ note boxes (23.1%) were less prevalent forms of explanatory notes within the evaluated assessment books. In all the assessment books that included explanatory notes, the notes were located in multiple locations, with the final portion of the book being one of them, thereby making it the most frequent placement. Explanatory notes were additionally observed in dedicated sections (28.6%) and at the beginning of individual chapters (42.9%). The quality scores for explanatory notes ranged from 17.0 to 26.0. The mean score achieved was 22.0, with a standard deviation of 2.8. Relative to the maximum possible score of 35, the mean score was 62.9% (standard deviation = 8.1%), with scores ranging from 48.6% to 74.3%. A one-sample *t*-test revealed that this mean score differed significantly from the passing score of 50%. With the exception of 'completeness of explanation' and 'uses of examples/ analogies', a statistically significant difference above the passing mark of 2.5 was observed for all other criteria evaluated ($p < 0.05$ using one-sample *t*-test vs. 2.5, Table 2). The mean scores and one-sample *t*-test results collectively indicated that all criteria either met or surpassed the passing threshold of 2.5 out of 5 (Table 2). Among the evaluated criteria, 'accuracy of contents' yielded the highest mean score (Table 2). 'Completeness of explanation' and 'Use of examples/analogies' received the lowest mean scores among the seven assessment categories (Table 2). The 'accuracy of contents' scored significantly higher than 'completeness of explanation' criteria ($p < 0.05$), as determined by ANOVA with a Bonferroni adjustment for multiple comparisons (Table 2).

Table 2: Quality Assessment of Explanatory Notes in Commercial Primary Four Science Assessment Books, Singapore (n=26)

Criterion	*Mean±SD*
Accuracy of Content	3.6±0.5*,[a]
Completeness of Explanation	2.9±0.4[b]
Clarity and Simplicity of Language	3.1±0.4*,[b]
Logical Flow and Structure	3.3±0.5*,[b]
Use of Examples/Analogies (if applicable)	2.9±1.3[b]
Addressing the "Why" and "How"	3.1±0.4*,[b]
Formatting and Presentation	3.1±0.4*,[b]
* $p < 0.05$ using one-sample *t*-test vs. passing score 2.5.	
[a,b] different superscripts represent $p < 0.05$ using ANOVA with Bonferroni adjustment.	

Question characteristics & quality assessment
All evaluated books contained questions in some format. Analysis of a sample of twenty-six assessment books, comprising a total of 6,140 questions, yielded a mean of 236.2 questions per book (standard deviation = 13.6), with values ranging from 220 to 265 questions. The number of pages dedicated to questions ranged from 12.9% to 91.2%, with a mean and standard deviation of 73.6% and 24.3%, respectively. Multiple-choice questions (MCQs) were the most prevalent format found in all the evaluated books. Following this, open-ended structured questions were the next most frequent, identified in 84.6% of the sample. True-false questions were present in only 7.7% of the evaluated books. An analysis of the questions revealed that all evaluated books addressed the first five domains of Bloom's Taxonomy: remembering, understanding, applying, analyzing, and evaluating. The distribution of questions across cognitive domains showed that 95.5% covered remembering, 89.8% covered understanding, 75.3% covered applying, 45.6% covered analyzing, and 24.3% covered evaluating. None of the evaluated books contained questions that addressed the highest-order domains of Bloom's Taxonomy: creating. An analysis of the evaluated books revealed that while questions addressed five of the six science process skills—observing, comparing, inferring, analyzing, and evaluating—there was a complete absence of questions requiring students to formulate a hypothesis. The questions were distributed across the five science process skills as follows: observing (95.5%), comparing (88.3%), inferring (55.8%), analyzing (43.4%), and evaluating (12.4%). The language of the evaluated questions was deemed clear and developmentally appropriate for the students. The contextual frameworks for questions in all evaluated books fell into two categories: abstract scientific and generic real-world situations. Notably, no questions utilized contexts drawn from a specifically Singaporean real-world environment. The contexts used in all the questions were familiar and relevant.

Discussion

The general characteristics of the assessment books selected for this study suggest they are representative of the commercially available Primary Four Science assessment books in Singapore. This representativeness is supported by complete adherence to study inclusion criteria, and relatively small standard deviations observed in book length, price, and publication year range. These consistent attributes enhance the generalizability of the findings to the broader market of supplementary science resources for primary schoolers in Singapore.

The evaluation of primary school assessment books reveals a market fraught with inconsistency and a fundamental disconnect regarding their pedagogical purpose. A critical finding is that only 53.8% of these books incorporate any form of explanatory notes, meaning nearly half fail to offer instructional support for independent learning and remediation, effectively serving merely as summative testing tools. The quality of explanatory notes exhibited considerable variability, with a range difference of 25.7% and a standard deviation of 8.1%, thereby indicating substantial disparities in quality. The overall mean quality score for these notes is a disappointing 62.9% (22 out of 35), which is statistically considered a bare pass and starkly inadequate for resources intended to support foundational learning. This pervasive mediocrity places a significant burden on learners and their guardians/ consumers to vet the quality of learning support.

Regarding the types of explanatory notes, there's a notable reliance on ‘concept summaries and overviews’, present in 46.2% of titles. While useful for revision, summaries are passive

and often fail to demonstrate knowledge application, aligning with the low scores for ‘Completeness of explanation’ and ‘Use of examples/analogies’ (Mayer et. al., 1996). There is a critical lack of pedagogical diversity, with a scarcity of powerful tools like concept maps, flowcharts, tables, or key points (Barta et. al., 2022; Odiliobi, 2021). These are vital for fostering higher-order thinking and visual understanding. Furthermore, ‘worked examples’, crucial for procedural and conceptual instruction, appear in only 38.5% of books, and ‘annotated diagrams/figures’ are not dominant despite their effectiveness for visual learners (Alnoori, 2023; Sinha & Kapur, 2021). Authors and publishers appear to favor static information over dynamic, process-oriented guidance, promoting recall over genuine understanding and application.

The physical placement of explanatory notes also poses a problem. The consistent placement of explanatory notes as answers at the end of every book reduces them to a reactive, post-hoc function. This creates significant cognitive and practical barriers for primary school learners, disrupting learning flow (Wittwer & Renkl, 2008). Conversely, the pedagogically sound ‘learn-first’ approach—placing notes at the beginning of individual chapters—was observed in only 20% of cases. This overwhelming preference for back-of-book placement confirms a design preference, prioritizing summative assessment over integrated, formative learning. Even a well-written explanation loses impact when physically separated from the problem it clarifies (Wittwer & Renkl, 2008).

The proportion of pages dedicated to explanatory notes also reveals a profound identity crisis within the market, ranging astonishingly from 5% to 77.3%. This demonstrates a complete lack of industry consensus on an assessment book's fundamental purpose. A book with only 5% notes is unequivocally a testing tool, while one with over three-quarters devoted to notes is effectively a textbook (Huang et. al., 2022; Rubin & Chisnell, 2008). The mean allocation of 32% is rendered almost meaningless by a substantial standard deviation of 26%, quantitatively proving the lack of a shared pedagogical philosophy guiding publishers. ‘Accuracy’ is the highest-scoring attribute of explanatory notes, which is reassuring as correct information is paramount in foundational learning. Accurate notes foster trust in learning resources and support autonomous study (Nowicki et. al., 2013). However, low scores in the areas of completeness of explanation and use of examples/ analogies raise significant pedagogical concerns (Obe, 2018). While accurate, the explanations are often incomplete or abstract, providing shallow learning opportunities (Obe, 2018). Examples and analogies are essential bridges for connecting new, abstract concepts to a learner’s existing knowledge, and their absence encourages rote learning over deep conceptual understanding (García-Carmona, 2021). While technical attributes like accuracy, clarity, and formatting score well, there is a profound weakness in true pedagogical efficacy. Notes may superficially address 'how' and 'why' questions but lack the completeness and examples necessary for deep understanding, succeeding in form but failing in core educational function (Nowicki et. al., 2013; Obe, 2018; García-Carmona, 2021).

In synthesis, the educational journey for parents or teachers seeking supportive resources is fraught with risk. They face a nearly one-in-two chance of selecting a book with no explanatory support, and if notes are present, their quality is highly inconsistent. This constitutes a significant market failure and places an immense burden on consumers. For primary education, which relies on building confidence and clear conceptual foundations, this lack of commitment to providing formative feedback is a profound disservice to young learners. The findings constitute a clear call for more rigorous editorial standards and a

greater commitment from publishers to ensure that all educational materials meet a much higher threshold of pedagogical effectiveness (Fan, 2010; Silvia & Rohaeti, 2022).
The analysis of primary school assessment books reveals their predominant function as tools for practice, drilling, and summative testing, a philosophy underscored by the allocation of nearly three-quarters (73.6%) of a book's pages to questions. This quantitative imbalance is significant, as a typical book dedicates more than double the space to testing questions compared to teaching through explanations, which average a mere 32% of page allocation. This clearly signifies an industry priority where extensive practice supersedes deep conceptual clarity. The vast range in question allocation, from 12.9% to 91.2%, mirrors the wide variation observed in explanatory content, confirming a profound lack of standardization and clear definition, with the 'assessment book' label inconsistently applied to products ranging from instruction-heavy guides to pure drill-and-practice workbooks. While practice is essential, this overwhelming emphasis risks promoting a performance-oriented mindset over genuine learning and inquiry (Fitzgerald & Smith, 2016; Obe, 2018).

The prevalence of MCQs underscores the emphasis on efficient, summative assessment, leveraging MCQs' strength in testing factual knowledge and recognition (Butler, 2018). However, this prevalence raises pedagogical concerns due to MCQs' inherent limitations in assessing higher-order thinking skills like synthesis, argumentation, or creative problem-solving, potentially training learners to prioritize recognition over deeper cognitive engagement (Butler, 2018). Crucially, a positive counterbalance is the widespread inclusion of open-ended structured questions, identified in 85.6% of the sample, which necessitates learners' active construction of answers and provides insight into their reasoning, information structuring, and knowledge application (BouJaoude, 2000). This dual approach suggests a pragmatic, albeit not always perfectly balanced, assessment design that attempts to cover both broad knowledge and deeper processing skills (Butler, 2018; BouJaoude, 2000). MCQs and open-ended structured questions are prevalent in the assessment books, most likely due to their prominence in the Singapore Primary School Leaving Examination format (Ministry of Education, Singapore, 2022).

A significant and universal limitation in the pedagogical value of these books is revealed through Bloom's Taxonomy: while all evaluated books consistently push beyond mere memorization, incorporating questions that require learners to remember, understand, apply, analyze, and evaluate, not a single book advances to the highest-order domain of 'Creating' (Chandio, 2021). This omission imposes a distinct cognitive limitation, effectively fostering critical thinking and analytical skills while systematically neglecting the development of innovative and inventive capacities. The learning process is confined to the mastery, application, and evaluation of existing knowledge, rather than encouraging the generation of novel ideas, synthesis into new forms, or formulation of original solutions. This phenomenon likely stems from the inherent challenges and subjective nature of evaluating creativity within standardized assessment frameworks. Consequently, learners are often trained to operate within established paradigms, rather than being encouraged to develop novel ones, thereby overlooking opportunities to cultivate original thinking and inventiveness (Starko, 2021).
This pattern is strongly mirrored in the analysis of science process skills: while there is commendable breadth in the consistent inclusion of skills such as observing, comparing, inferring, analyzing, and evaluating, the universal and complete absence of questions requiring learners to formulate a hypothesis is a profound pedagogical omission (Gizaw & Sota, 2023). Formulating a hypothesis is the intellectual spark of the scientific method, the crucial step where a student transitions from a consumer of information to an active participant in inquiry, requiring curiosity, synthesis, and a creative leap (Sutiani, 2021). Its

absence aligns perfectly with the omission of the 'Creating' domain in Bloom's Taxonomy (Sutiani, 2021). These books train learners to be proficient practitioners of science, but fail to provide the opportunity to initiate their own scientific investigations (Gizaw & Sota, 2023). A fundamental strength is that the question language is consistently clear and developmentally appropriate, a crucial prerequisite ensuring that assessments test subject matter knowledge and cognitive skills, not reading comprehension or ability to decipher ambiguous phrasing (Osborne & Pimentel, 2023). This demonstrates professional attention to the target audience, guaranteeing accessibility and a fair opportunity for learners to engage with tasks (Osborne & Pimentel, 2023). This linguistic clarity starkly highlights the previously identified pedagogical shortcomings, indicating that limitations do not stem from basic carelessness or lack of production quality. Authors and publishers are evidently capable of crafting clear and appropriate content, making the universal absence of tasks requiring learners to 'create' or 'formulate a hypothesis', and the systemic lack of 'completeness' in explanatory notes, appear less like an oversight and more like a deliberate, albeit misguided, design choice. The problem, therefore, lies not with the prose but with the pedagogy; the books are clear, but they clearly communicate a limited educational vision that proficiently guides students up to analysis and evaluation but systematically stops short of fostering true innovation and inquiry.

Furthermore, while all question contexts were found to be familiar and relevant, minimizing extraneous cognitive load and ensuring fair assessment, these contexts were restricted to abstract scientific or generic real-world situations, with a complete and notable absence of specifically Singaporean settings. This indicates a critical missed opportunity for effective pedagogy, which often leverages culturally responsive practices to make learning more meaningful and authentic (Chin & Osborne, 2008). Omitting local contexts such as national transport systems, hawker centres, or indigenous flora and fauna prevents anchoring abstract concepts within students' lived environments, suggesting a prioritization of universally marketable, generic content over pedagogically superior, localized materials (Deehan et. al., 2022). While functionally sound, this approach forgoes a powerful tool for enhancing learner engagement and affirming cultural identity, limiting the depth and resonance of the learning experience (Deehan et. al., 2022).

Finally, the analysis of question volume reveals a remarkable degree of market standardization and uniformity and suggests an implicit industry consensus on the quantity of practice material for a commercially viable product. This consistency in volume, however, starkly contrasts with the significant variation in the quality, format, and pedagogical depth of instructional content, indicating that while authors and publishers have converged on a standard for quantifiable practice, no such standard exists for qualitative aspects of learning support. The result indicates a dominant design philosophy prioritizing the delivery of a high volume of predictable questions, thereby positioning these books as tools for drilling and summative practice rather than instructional resources. This approach suggests that market value may be more closely tied to content quantity than pedagogical effectiveness.

Conclusion

Primary school assessment books predominantly serve as instruments for practice and summative evaluation, allocating approximately three-quarters of their content to questions, with a marked imbalance in favor of assessment over instructional material. A significant pedagogical concern is the frequent omission or inadequacy of explanatory notes, which

often lack exemplars, are incomplete, or are inconveniently located, thereby impeding autonomous learning. Although the questions themselves are generally clear and accurate, the resources are uniformly constrained by a cognitive ceiling that fails to engage learners in higher-order thinking tasks, such as creation or hypothesis formulation. This suggests that the market prioritizes quantity and standardization over comprehensive, inquiry-based learning, resulting in resources with limited pedagogical value.

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