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Complex Concepts in Simple Language: a Linguistic Perspective on Why Romanian Secondary School Science Textbooks Struggle to Promote Effective Learning

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Abstract

The ability to simplify complex concepts is essential in educational materials. Studies have shown that simplified, well-structured texts improve comprehension and learning outcomes, particularly for younger students [1], [2]. This is especially relevant for young school children, who are often required to engage with advanced topics at ages when their cognitive capacities are still developing [3]. This study analyses the linguistic complexity of Romanian 6th grade textbooks in biology and physics, using ROTEX - the Romanian Corpus of School Textbooks [4], which includes widely used textbooks in Romanian education. The analysis is based on the linguistics-related textbook analysis framework (LTAF) [5], evaluating linguistic density (LTAF 1), the balance between textual and visual elements (LTAF 2), overall readability (LTAF 4), and disciplinary terminology complexity (LTAF 6). The findings indicate that all textbooks have excessive linguistic density, surpassing expected cognitive loads for 6th graders (LTAF 1). The balance between text and visuals is inconsistent, with some textbooks presenting excessive fragmentation, while others rely heavily on dense theoretical content (LTAF 2). Readability assessments (LTAF 4), employing the LEMI Readability Index [6] and additional international measures such as Flesch-Kincaid Reading Ease and Gunning-Fog, to assess text accessibility show that most textbooks exceed recommended difficulty levels [3], often aligning with high school or even college-level texts. Additionally, disciplinary terminology is too complex (LTAF 6), with the premature introduction of specialised disciplinary terms that limit accessibility and engagement [7]. The contrast with international best practices highlights the misalignment between textbook design and student learning needs, indicating that Romanian science textbooks need to prioritise simplification over redundancy and improve their pedagogical effectiveness. The findings highlight the urgent need for linguistic validation in the design of Romanian school science textbooks, ensuring that disciplinary knowledge is presented in a structured, clear, and age-appropriate manner.

Keywords: *linguistics of textbooks, textbook corpus, science school textbooks, Romanian school textbook design, effective learning, Romanian education*

1. Rationale of the Study

Even if AI technologies are currently impacting education in general, and school education in particular, teaching materials remain a cornerstone of effective learning. School textbook design is an essential component of the knowledge transfer process. If textbooks lack structure, coherence, guidance for independent work, and effective practice techniques, they are perceived as learning obstacles instead of learning facilitators. This is particularly true for hard sciences, where clear explanations and progressive task structuring can result in either student motivation or discouragement. Among the factors that influence the success of a textbook in promoting effective learning in sciences is language. There are several linguistic features that facilitate understanding and learning, such as cohesion [8], [9], coherence [10], disciplinary terminology, and overall text readability [5].

The linguistic investigation of school science textbooks in the Romanian context has never been performed. This study aims to further implement the linguistics-related textbook analysis framework (LTAF), developed by Chitez (2024) [5], for the extraction of features in Romanian 6th grade textbooks in biology and physics using ROTEX – the Romanian Corpus of School Textbooks [4]. The analysis provides a research-based, replicable model for school textbook validation from a linguistic perspective. Moreover, the comparative case study in section 3.4, which contrasts Romanian textbooks with international textbooks used in English-speaking communities of practice, provides valuable insights on their critical linguistics-related components while also offering targeted suggestions for improvement.

2. Research on the Design of School Science Textbooks

2.1. General Aspects

A key aspect of science textbook research is the representation of disciplinary knowledge and its alignment with curricula. Studies highlight discrepancies between textbook content and national guidelines, leading to either content overload or insufficient conceptual structuring [11], [12]. This coherence is particularly crucial in biology and physics, where a well-structured sequence of topics enhances knowledge retention and conceptual application [13]. The role of visual elements has also been widely explored, with research emphasizing that well-designed diagrams and illustrations improve comprehension, whereas excessive or poorly integrated graphics can overwhelm learners and reduce efficiency [14], [15]. The balance between textual and visual components is essential for accommodating diverse learning styles [16], and structured visual aids, such as step-by-step diagrams, significantly enhance conceptual grasp [17]. The incorporation of multimodal elements, including interactive visuals, has been shown to strengthen engagement and deepen comprehension by linking abstract scientific concepts with prior knowledge [18]. Advances in AI-driven tools, such as Multimodal Large Language Models (MLLMs), further expand learning opportunities by dynamically embedding relevant visuals into educational content [19]. Research suggests that this approach improves understanding, motivation, and participation [20]. However, an excessive influx of multimodal components can distract rather than aid learners, making thoughtful selection and integration essential for maximising educational benefits [14], [21].

2.2. Linguistic Aspects

Some of the relevant linguistics-related topics in textbook design refer to readability and linguistic complexity [5], since these parameters significantly impact students' comprehension and engagement. Research shows that high lexical density, complex sentence structures, and specialised terminology can impede understanding, particularly for younger learners [22], [23]. Studies emphasise the need to balance academic rigour with readability to facilitate learning without excessive cognitive strain [24]. Many textbooks exceed recommended readability levels, leading to disengagement and comprehension difficulties [25], [26]. Beyond readability, disciplinary terminology and discourse structure also play a critical role in scientific literacy. Students must not only decode text but also understand specialised vocabulary and discourse conventions [27], [26]. Introducing complex terminology without adequate support can challenge comprehension and engagement [23]. Additionally, textbooks often lack explicit explanations or contextualisation of scientific terms, forcing students to infer meanings from dense text [22]. The discourse style of science textbooks further influences comprehension. Research indicates that their authoritative and impersonal tone, frequent use of passive voice, and dense declarative statements can make content less accessible [28], [15], [14]. Effective structuring of information is crucial, as poor sequencing can lead to fragmented knowledge acquisition and difficulty in linking concepts [16], [13]. Multimodal elements and linguistic scaffolding help support students' understanding. Integrating explanatory diagrams, glossaries, and structured summaries enhances information processing [25], [24]. However, ineffective visual integration, such as irrelevant or excessive graphics, can create confusion rather than aid learning [20]. Strategic use of multimodal elements ensures terminology is introduced progressively and reinforced effectively [12].

To address linguistic overload in Romanian school textbooks, the linguistics-related textbook analysis framework (LTAF) was developed [5]. Prior applications of LTAF [ibid.] revealed significant concerns regarding linguistic overload in Romanian textbooks, particularly in subjects like mathematics and Romanian language and literature, where excessive terminology and complex instructional structures often limit comprehension.

3. Method, Analysis and Results

3.1 Data and Approach

The study uses the ROTEX, the Romanian corpus of School Textbooks [4].Specifically, it examines the two sub-corpora ROFIZ-6 and ROBIO-6, which contain four and seven ministry-approved textbooks, respectively, accessible at manuale.edu.ro. The analysis is framed within the linguistics-related textbook analysis framework (LTAF) proposed by Chitez [5], focusing on linguistic

density (LTAF 1), the balance of text and visual elements (LTAF 2), and the readability and complexity of terminology (LTAF 4 and LTAF 6). The primary focus is on terminology usage and linguistic complexity, evaluating whether these textbooks present excessive cognitive demands that hinder effective learning.

3.2 Linguistic Density

Linguistic density corresponds to LTAF 1 in Chitez's [5] textbook analysis framework, and it refers to the amount of textual content per page in a textbook, measured as words per page (WPP). This metric is crucial for evaluating the cognitive demands placed on students, as higher linguistic density requires greater reading effort, comprehension skills, and cognitive processing. Chitez [ibid.] emphasizes that excessive linguistic density can lead to cognitive overload [3], making it difficult for students to retain information and engage with learning materials effectively. On the other hand, textbooks with very low linguistic density may lack depth, potentially reducing the clarity of explanations and the completeness of conceptual instruction.

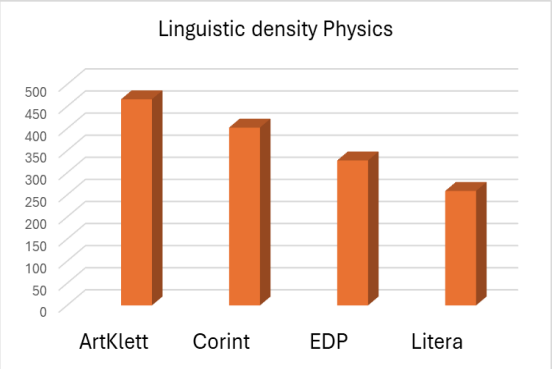


Fig. 1. Linguistic density/WPP (LTAF 1) in ROFIZ-6

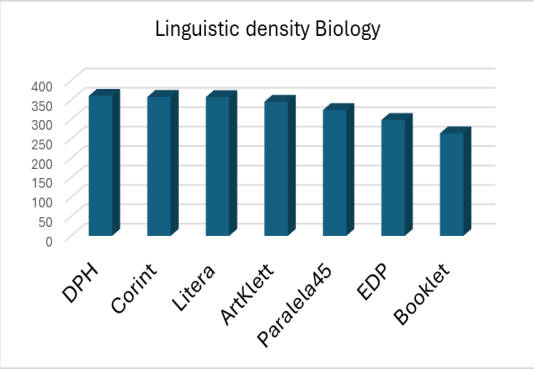


Fig. 2. Linguistic density/WPP (LTAF 1) in ROBIO-6

As visible in Figures 1 and 2, Corint and Litera emerge as publishers with consistently dense textbooks in both Physics and Biology, emphasizing detailed textual content. ArtKlett is particularly dense in physics textbooks, while DPH leads in linguistics density in biology textbooks. On the other hand, EDP and Booklet favour a more visually integrated and activity-driven approach, resulting in lower textual density. These differences highlight varying pedagogical strategies, catering to different learning preferences and instructional methodologies. Among Physics textbooks, ArtKlett exhibits the highest WPP (466), indicating the densest textual content, likely with extensive theoretical discussions and in-depth explanations. Corint follows with 402 WPP, maintaining a strong textual presence. EDP, with a WPP of 328, falls into a mid-range density, suggesting a balance between text and non-textual elements. Litera, with the lowest WPP (259), likely integrates more graphics, diagrams, and interactive learning tools, reducing text density. In Biology, DPH presents the highest WPP (360), closely followed by Litera (357 WPP) and Corint (358 WPP), indicating textbooks that prioritize textual content. ArtKlett (345 WPP) follows a similar pattern, while EDP (298 WPP) and Booklet (264 WPP) are the least text-dense Biology textbooks, favouring a greater reliance on visual aids and structured learning activities. Notably, Paralela45 maintains a moderate WPP (324), reflecting a consistent editorial strategy across different edition.

3.3 Visual Elements and their Relationship to the Text

The analysis of redundancy and excessive visual elements (LTAF 2) in 6th grade physics textbooks reveals significant disparities in content organization and readability. Litera emerges more structured, requiring minor refinements, while EDP maintains a reasonable balance despite some text-heavy sections. In contrast, ArtKlett and Corint suffer from excessive visual fragmentation, with Corint ranking the lowest due to frequent interruptions and overwhelming instructional elements. For biology textbooks**,** the analysis reveals varying degrees of inefficiency in instructional design. Paralela 45 and DPH rank the lowest, as their excessive fragmentation, unnecessary text boxes, and overwhelming visuals disrupt reading flow. Corint and ArtKlett also require significant simplification, as their cluttered layouts reduce readability. Litera, while more structured, still contains redundant visual elements that

could be streamlined for clarity. Booklet, though less cluttered than the others, still exhibits a high degree of redundancy, indicating the need for further refinement.

The readability (LTAF 4) analysis of all physics textbooks using LEMI (lemi.ro) and Readability (readabilit.com) platforms shows that their complexity far exceeds the cognitive level of 6th grade students, with an estimated 9th-10th grade readability and classification as "difficult" (ArtKlett) to "extremely difficult" to read. The Flesch-Kincaid Reading Ease and Gunning-Fog Index further confirm that all the textbooks approach college-level difficulty, relying on dense terminology and complex sentence structures. Moreover, EDP, Corint, and Litera textbooks reach 11th-12th grade readability, requiring an advanced academic background for full comprehension. The readability analysis of biology textbooks mirrors the trends observed in the physics materials, with all texts demonstrating a significant mismatch between their complexity and the intended 6th grade audience. The LEMI scores indicate that most biology textbooks exceed the 12th grade level, with only one exception (EDP) at 10th grade, still far beyond the expected middle school readability. Similarly, the Flesch-Kincaid Reading Ease and Gunning-Fog Index classify these texts as "extremely difficult to read," aligning them with professional or even college-level materials.

3.4. Case Study Analyses of Disciplinary Terminology: a Contrastive Approach

The close analysis of the ArtKlett 6th-grade physics textbook identifies several critical aspects related to disciplinary terminology (LTAF 6). One of the most striking issues is the excessive use of high-level technical terms (see terminology category examples in Table 1), which often exceed the comprehension level expected from 6th-grade students. Compared to internationally recognized middle school science curricula, such as CK-12 Foundation FlexBooks [31], teaching materials by Evan-Moor Educational Publishers [29], and REAL Science Odyssey by Pandia Press [32], the ArtKlett textbook is overly dense in text, highly theoretical, and difficult to navigate. One example of terminological overload is the discussion on "levitație magnetică" ("magnetic levitation", p.103). The explanation delves into forces between magnetic poles and real-world applications, such as Maglev trains, without providing sufficient conceptual scaffolding. In contrast, CK-12 Foundation FlexBooks introduce magnetism gradually, using visual models, guided inquiry, and real-world examples before engaging in deeper technical discussions [31]. This structure helps students build intuition before encountering complex physical interactions. Similarly, the explanation of "reflexia totală a luminii" ("total reflection of light", p.138) presents concepts like the critical angle, refractive indices, and light propagation through different media in a way that is more aligned with high school physics rather than introductory middle school lessons. Evan-Moor Educational Publishers take a more structured approach to light phenomena, introducing mirrors, lenses, and simple refraction experiments before progressing to more advanced topics [29]. This step-by-step method allows students to develop an intuitive understanding of optics before engaging with its mathematical formalism.

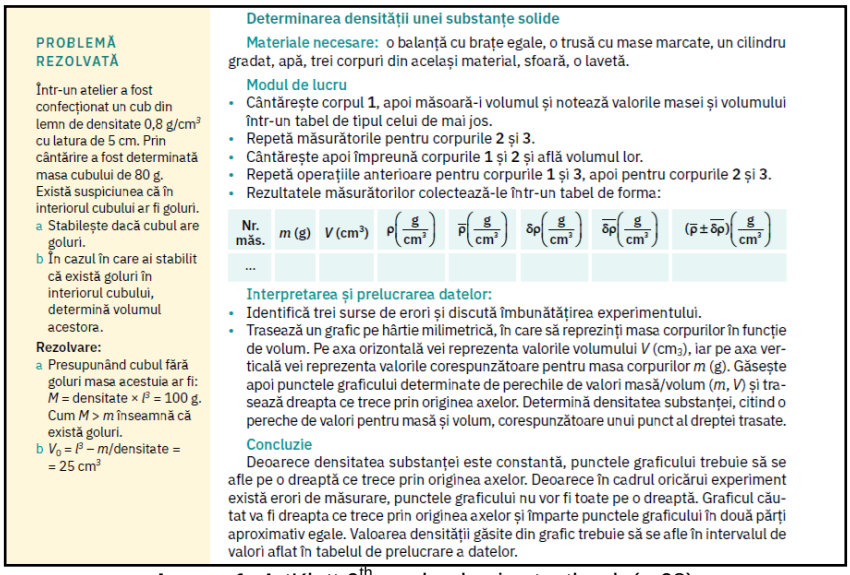
Basic terms	Intermediate terms	Advanced terms
apă, magnet, lumina, lentilă, viteza, masa, kilogram, circuit, baterie, bec	*intensitatea curentului electric, intensitatea luminoasă, nemiscibile, interacțiunea dintre magneți, linii de câmp magnetic, desublimare, neelectrizat, voltmetru, ampermetru*	*mișcarea rectilinie uniform variată, telemetrul cu laser, ciocuri solidare cu cursorul, șurub de de avans fin, hectometrul cub, eroare relativă de măsurare, eroarea absolută medie, proprietate termometrică, anomalia termică a apei, magnetosfera, levitație magnetică*

Table 1. Terminology category examples in ArtKlett 6th grade physics textbook

A significant issue in the ArtKlett textbook is its rigid mathematical approach to physics, often prioritizing equations over conceptual explanations. The section on "accelerația medie" ("average acceleration", p.57-58) defines acceleration using the formula $a=\Delta_v / \Delta_t$, assuming that 6th grade students are already comfortable with algebraic manipulation. However, at this stage, most students are just beginning to develop fluency with proportional reasoning, making this overly ambitious and inaccessible. In contrast, *REAL Science Odyssey* by Pandia Press introduces motion and forces through interactive activities, graphical representations, and everyday analogies, ensuring students understand qualitative principles before engaging in quantitative analysis [32].

Another example of upper-level mathematical misalignment with 6th grade physics concepts, is the presentation of density calculations (see Image 1). While density as a concept can be introduced

qualitatively, or the basic formula ρ = m / V can be demonstrated through hands-on experiments, the accompanying mathematical concepts make the concept overly complex, assuming that students are proficient in algebraic manipulation and proportional reasoning, which are typically developed in later grades. Moreover, the textbook incorporates advanced data analysis techniques such as error estimation, mean deviation (δρ), and graphical regression, concepts that require familiarity with statistical uncertainty, coordinate geometry, and algebraic modelling, skills generally introduced in 8th or 9th grade. By presenting these topics prematurely, the textbook imposes unnecessary complexity, potentially leading to confusion rather than conceptual understanding.



PROBLEMĂ REZOLVATĂ

Într-un atelier a fost confecționat un cub din lemn de densitate 0,8 g/cm³ cu latura de 5 cm. Prin cântărire a fost determinată masa cubului de 80 g. Există suspiciunea că în interiorul cubului ar fi goluri.

a Stabilește dacă cubul are goluri.

b În cazul în care ai stabilit că există goluri în interiorul cubului, determină volumul acestora.

Rezolvare:

a Presupunând cubul fără goluri masa acestuia ar fi: M = densitate × l^3 = 100 g. Cum $M > m$ înseamnă că există goluri.

b $V_0 = l^3 - m$/densitate = = 25 cm³

Determinarea densității unei substanțe solide

Materiale necesare: o balanță cu brațe egale, o trusă cu mase marcate, un cilindru gradat, apă, trei corpuri din același material, sfoară, o lavetă.

Modul de lucru

- Cântărește corpul **1**, apoi măsoară-i volumul și notează valorile masei și volumului într-un tabel de tipul celui de mai jos.
- Repetă măsurătorile pentru corpurile **2** și **3**.
- Cântărește apoi împreună corpurile **1** și **2** și află volumul lor.
- Repetă operațiile anterioare pentru corpurile **1** și **3**, apoi pentru corpurile **2** și **3**.
- Rezultatele măsurătorilor colectează-le într-un tabel de forma:

Nr. măs.	m (g)	V (cm³)	$\rho\left(\frac{g}{cm^3}\right)$	$\overline{\rho}\left(\frac{g}{cm^3}\right)$	$\delta\rho\left(\frac{g}{cm^3}\right)$	$\overline{\delta\rho}\left(\frac{g}{cm^3}\right)$	$(\overline{\rho} \pm \overline{\delta\rho})\left(\frac{g}{cm^3}\right)$
...							

Interpretarea și prelucrarea datelor:

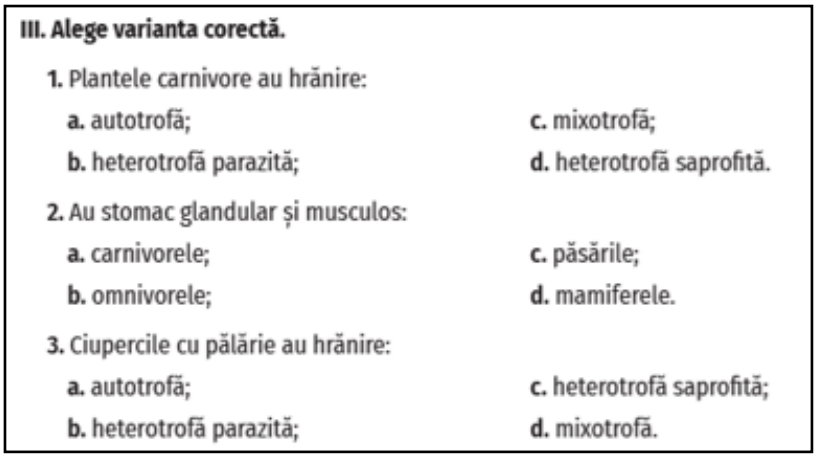
- Identifică trei surse de erori și discută îmbunătățirea experimentului.
- Trasează un grafic pe hârtie milimetrică, în care să reprezinți masa corpurilor în funcție de volum. Pe axa orizontală vei reprezenta valorile volumului V (cm_3), iar pe axa verticală vei reprezenta valorile corespunzătoare pentru masa corpurilor m (g). Găsește apoi punctele graficului determinate de perechile de valori masă/volum (m, V) și trasează dreapta ce trece prin originea axelor. Determină densitatea substanței, citind o pereche de valori pentru masă și volum, corespunzătoare unui punct al dreptei trasate.

Concluzie

Deoarece densitatea substanței este constantă, punctele graficului trebuie să se afle pe o dreaptă ce trece prin originea axelor. Deoarece în cadrul oricărui experiment există erori de măsurare, punctele graficului nu vor fi toate pe o dreaptă. Graficul căutat va fi dreapta ce trece prin originea axelor și împarte punctele graficului în două părți aproximativ egale. Valoarea densității găsite din grafic trebuie să se afle în intervalul de valori aflat în tabelul de prelucrare a datelor.

Image 1. ArtKlett 6th grade physics textbook (p.68)

The handling of measurement errors in the ArtKlett textbook further exemplifies its theoretical and technical bias. The chapter on "erori sistematice și accidentale" ("systematic and accidental errors", p.33) provides an in-depth breakdown of instrument calibration, absolute vs. relative uncertainty, and precision errors, concepts more commonly found in high school laboratory manuals. In contrast, Evan-Moor's science materials integrate error analysis within simple hands-on experiments, guiding students to recognize sources of uncertainty naturally as they measure and record data [29]. The interactive approach makes measurement uncertainty a practical learning experience rather than an abstract theoretical discussion. Beyond the terminology itself, the didactic structure of the textbook creates further obstacles to effective learning. Unlike international science textbooks, which prioritize modular lessons, interactive elements, and clearly separated sections, the ArtKlett textbook follows a dense, uninterrupted format. The section on "precizia unui experiment" ("precision of an experiment", p.32) exemplifies this issue by presenting a purely theoretical discussion rather than integrating it into an experimental context. In contrast, CK-12 Foundation FlexBooks and Evan-Moor materials encourage exploration through structured exercises, guided observations, and self-directed inquiries, which enhance comprehension and engagement [31], [29]. Similarly, international 6th-grade physics textbooks present density as a hands-on, experiential learning activity rather than an abstract mathematical derivation. For example, the CK-12 Physical Science for Middle School FlexBook provides an interactive lesson on density, where students engage in a structured step-by-step process [33]. Such a scaffolded approach ensures that students first develop an intuitive understanding before engaging in mathematical representations.



III. Alege varianta corectă.

1. Plantele carnivore au hrănire:

a. autotrofă; **c.** mixotrofă;

b. heterotrofă parazită; **d.** heterotrofă saprofită.

2. Au stomac glandular și musculos:

a. carnivorele; **c.** păsările;

b. omnivorele; **d.** mamiferele.

3. Ciupercile cu pălărie au hrănire:

a. autotrofă; **c.** heterotrofă saprofită;

b. heterotrofă parazită; **d.** mixotrofă.

Image 2. Booklet 6th grade biology textbook (p.52)

For biology, a sample analysis was performed on the Booklet textbook (Image 2), whose overall readability was, in fact, lower than the rest. The terminology used (see Image 2), incorporates terms like *mixotrofă* (“mixotroph”) or *heterotrofă saprofită* (“saprophytic heterotroph”) which are typically introduced at the high school or even introductory college level.

As the case of physics textbooks, International biology textbooks, such as those from the *CK-12 Foundation or Oxford University Press*, adopt a more gradual approach, introducing concepts in accessible language before using specialised terms. For instance, rather than immediately defining "mixotrofă," an international textbook might explain that some organisms both produce their own food and consume others for energy, ensuring comprehension before technical classification. Additionally, text density is significantly lower in international materials, which rely on visual aids, real-world analogies, and simplified explanations to enhance accessibility.

4. Discussion and Conclusions

The findings confirm that all analysed science (i.e., physics and biology) textbooks exceed the expected cognitive level for 6th graders, reinforcing concerns about textbook accessibility and pedagogical effectiveness in Romanian secondary education. A key factor in this challenge is linguistic density (LTAF 1), which measures the amount of textual content per page (WPP) and directly influences the cognitive demands placed on students [5]. In physics textbooks, ArtKlett exhibits the highest linguistic density, with 466 WPP, suggesting a highly theoretical approach, followed by Corint (402 WPP). In contrast, EDP (328 WPP) and Litera (259 WPP) integrate more visuals and activities, balancing text with non-textual elements. In biology textbooks, DPH (360 WPP), Litera (357 WPP), and Corint (358 WPP) rank highest, prioritizing dense textual explanations, while Booklet (264 WPP) and EDP (298 WPP) maintain the lowest WPP, displaying more interactive and visually guided learning.

The analysis of visual elements (LTAF 2) and readability (LTAF 4) in 6th grade science textbooks highlights significant disparities in instructional design and accessibility. While Litera and Booklet exhibit more structured layouts, others, such as Corint and ArtKlett in physics, and Paralela 45 and DPH in biology, suffer from visual fragmentation and content redundancy, disrupting textual flow and increasing cognitive load [3]. In fact, all assessed textbooks are characterized by excessive visual design. The prevalent use of redundant visual elements in textbooks, such as excessive colouring, decorative images, and unnecessary informational boxes, contradicts established educational guidelines that advocate for minimalist design to enhance learning efficacy. Research indicates that superfluous visuals, often referred to as "seductive detail" versions of text, diminish recall of structurally important ideas [34, p. 250]. Such details can distract learners, impeding comprehension and retention of core material. The lexical density and visual redundancy is confirmed by all applied readability indices (LEMI, Flesch-Kincaid, and Gunning-Fog), which consistently indicate that the evaluated textbooks reach high school or even entry college level readability, making them inaccessible to their intended audience.

The case study analysis of disciplinary terminology (LTAF 6) confirms that Romanian secondary school science textbooks use excessively complex disciplinary terminology, which may impact student comprehension. The ArtKlett 6th grade physics textbook, for instance, presents terminology and mathematical formalism more appropriate for high school or even introductory college levels. In contrast, international textbooks such as CK-12 FlexBooks and Evan-Moor Educational Publishers textbooks follow a scaffolded, student-friendly approach, introducing concepts gradually and reinforcing them through structured explanations, real-world analogies, and interactive exercises. The overly technical nature of Romanian textbooks creates a disconnect between content complexity and student comprehension, which can lead to lack of motivation for science learning.

The misalignment between textbook design and student learning needs, as highlighted by LTAF 1 (linguistic density), LTAF 2 (text-visual balance), LTAF 4 (readability), and LTAF 6 (terminology), underscores the urgent need for linguistic validation in Romanian middle school science education. This study reinforces the importance of adopting evidence-based textbook design frameworks, such as LTAF [5] to ensure that school textbooks are linguistically validated to function as effective learning instruments. The contrast with international materials highlights the necessity of reevaluating Romanian science textbooks, with a focus on linguistic density, better integration of visuals and interactive elements, improved instructional flow, overall readability, and terminology simplification. All linguistics-related textbook design features are interconnected and fundamentally leading to one main principle: disciplinary knowledge is effectively transferred when principles of simplification are prioritised over those of complexity. In other words, students will perform better in science if complex scientific concepts are made accessible through simple, well-structured age-adapted language.

REFERENCES

[1] Berendes, K., Vajjala, S., Meurers, D., Bryant, D., Wagner, W., Chinkina, M., & Trautwein, U. (2018). Reading demands in secondary school: Does the linguistic complexity of textbooks increase with grade level and the academic orientation of the school track?. *Journal of Educational Psychology*, *110*(4), 518-543.

[2] Hiebert, E. H., Pearson, P. D., Hiebert, E. H., & Pearson, P. D. (2010). An examination of current text difficulty indices with early reading texts. *Reading research report*, *10*. TextProject, Inc.

[3] Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. *Cognitive Science*, 12(2), 257–285.

[4] Oraviţan, A., Chitez, M., & Rogobete, R. (2023). A Linguistically-Informed Assessment Model for Multidimensional Competence Building in Romanian School Writing. *Educatia 21*, 85-91.

[5] Chitez, M. (2024). Linguistic Overload in Secondary School Textbooks: A Corpus-Informed Case Study of Romanian 6th Grade Textbooks. In *Proceedings of the International Conference Innovation on Language Learning 2024*, available at: https://conference.pixel-online.net/files/ict4ll/ed0017/FP/3177-CDEV6983-FP-ICT4LL17.pdf.

[6] Chitez, M., Dascalu, M., Udrea, A. C., Strilețchi, C., Csürös, K., Rogobete, R., & Oraviţan, A. (2024, May). Towards Building the LEMI Readability Platform for Children's Literature in the Romanian Language. In *Proceedings of the 2024 Joint International Conference on Computational Linguistics, Language Resources and Evaluation (LREC-COLING 2024*) (pp. 16450-16456).

[7] O'Keeffe, L. (2013). A Framework for Textbook Analysis. *International Review of Contemporary Learning Research*, 2(1), 1-1.

[8] Halliday, M. A. K., & Hasan, R. (1976). *Cohesion in English.* Longman.

[9] Graesser, A. C., McNamara, D. S., Louwerse, M. M., & Cai, Z. (2004). Coh-Metrix: Analysis of text on cohesion and language. *Behavior Research Methods, Instruments, & Computers, 36(2),* 193-202.

[10] O'Reilly, T., & McNamara, D. S. (2007). The impact of science knowledge, reading skill, and reading strategy knowledge on more versus less coherent text comprehension. *Learning and Instruction, 17(6),* 511-528.

[11] Liu, Y., & Treagust, D. F. (2013). Content analysis of diagrams in secondary school science textbooks. *In Critical Analysis of Science Textbooks: Evaluating Instructional Effectiveness* (pp. 287-300). Dordrecht: Springer Netherlands.

[12] Rusilowati, A., Nugroho, S. E., & Susilowati, S. M. (2016). Development of science textbook based on scientific literacy for secondary school. *Jurnal Pendidikan Fisika Indonesia, 12(2),* 98-105.

[13] Yu, J., Li, C., & Li, G. (2022). Alignment between biology curriculum standards and five textbook editions: A content analysis. *International Journal of Science Education, 44(14),* 1-20.

[14] Román, D., & Busch, K. C. (2016). Textbooks of doubt: Using systemic functional analysis to explore the framing of climate change in middle-school science textbooks. *Environmental Education Research, 22(8),* 1158-1180.

[15] Akcay, H., Kapıcı, H. O., & Akcay, B. (2020). Analysis of the representations in Turkish middle school science textbooks from 2002 to 2017. *Participatory Educational Research, 7(3),* 192-216.

[16] Dimopoulos, K., Koulaidis, V., & Sklaveniti, S. (2003). Towards an analysis of visual images in school science textbooks and press articles about science and technology. *Research in Science Education, 33,* 189-216.

[17] Morris, B. J., Masnick, A. M., Baker, K., & Junglen, A. (2015). An analysis of data activities and instructional supports in middle school science textbooks. *International Journal of Science Education, 37(16),* 2708-2720.

[18] Batir, S. B., & Akçay, H. (2022). Effects of multimodal representations on students' science learning. In O. Noroozi & I. Sahin (Eds.), *Proceedings of IHSES 2022-- International Conference on Humanities, Social and Education Sciences* (pp. 198-202), Los Angeles, USA. ISTES Organization.

[19] Bewersdorff, A., Hartmann, C., Hornberger, M., Seßler, K., Bannert, M., Kasneci, E., Kasneci, G., Zhai, X., & Nerdel, C. (2025). Taking the next step with generative artificial intelligence: The transformative role of multimodal large language models in science education. *Learning and Individual Differences, 118,* 102601.

[20] Cheung, K. K. C., Pun, J., Kenneth-Li, W., & Mai, J. (2024). Exploring students' multimodal representations of ideas about epistemic reading of scientific texts in generative AI tools. *Journal of Science Education and Technology,* 1-14. https://doi.org/10.1007/s10956-024-10182-0

[21] Singh, J., Zouhar, V., & Sachan, M. (2023). Enhancing textbooks with visuals from the web for improved learning. *arXiv preprint arXiv:2304.08931.*

[22] Bakken, J., & Andersson-Bakken, E. (2021). The textbook task as a genre. *Journal of Curriculum Studies, 53(6),* 729-748.

[23] Zhuang, H., Xiao, Y., Liu, Q., Yu, B., Xiong, J., & Bao, L. (2021). Comparison of nature of science representations in five Chinese high school physics textbooks. *International Journal of Science Education, 43(11),* 1779-1798.

[24] Hu, J., Gao, X., & Qiu, X. (2021). Lexical coverage and readability of science textbooks for English-medium instruction secondary schools in Hong Kong. *Sage Open, 11(1),* 21582440211001867.

[25] Sideri, A., & Skoumios, M. (2021). Science process skills in the Greek primary school science textbooks. *Science Education International, 32(3),* 231-236.

[26] Lopez, E. N. B., Maraño, C. M. B., Origenes, R. W., Pizaña, A. D., Salmo, J. M., & Picardal, J. P. (2022). Content analysis of cell division concepts in senior high school biology textbooks. *Journal of Biological Education Indonesia (Jurnal Pendidikan Biologi Indonesia), 8(2),* 159-177.

[27] Dogan, O. K. (2021). Methodological? Or dialectical?: Reflections of scientific inquiry in biology textbooks. *International Journal of Science and Mathematics Education, 19(8),* 1563-1585.

[28] Knain, E. (2001). Ideologies in school science textbooks. *International Journal of Science Education, 23(3),* 319-329.

[29] Evan-Moor Educational Publishers. (2020). *Science lessons and investigations, grade 6*. Evan-Moor Educational Publishers.

[30] Evan-Moor Educational Publishers. (2009). Daily science, grade 6+. Evan-Moor Educational Publishers.

[31] CK-12 Foundation. (2024). *CK-12 Foundation FlexBooks*. Retrieved from: https://www.ck12.org/fbbrowse/

[32] Pandia Press. (2022). *REAL Science Odyssey*. Retrieved from: https://www.pandiapress.com/real-science-odyssey/

[33] CK-12 Foundation. (2024). *CK-12 Physical Science for Middle School*. Retrieved from: https://www.ck12.org/fbbrowse/

[34] Garner, R., Brown, R., Sanders, S., & Menke, D. J. (1992). Seductive details and learning from text. In *The role of interest in learning and development*, 239-254.