Interacting factors influencing reading in a digital world: Towards an integrative framework

Conceptual Framework of LeesEvolutie

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Reading and reading instruction are investigated by researchers and educators from many different disciplines. These disciplines differ considerably in how they conceptualize 'reading', in the research methods they use, in the factors they deem central to improving reading education, in terminology, and in other aspects. The purpose of the LeesEvolutie framework is to bring together these multidisciplinary perspectives on reading and reading instruction. In doing so, it provides a conceptual framework that facilitates interdisciplinary communication and collaboration as well as captures the richness of reading as a complex activity—with many purposes, component processes, various types of knowledge, challenges, experiences, etc. It highlights that reading among youth is the emergent property of a complex system of interacting elements operating at different levels (individual, interpersonal, educational, organizational, social, environmental, economic, technological, political). The functioning of the system reflects the dynamic interactions between these elements.

The framework brings together the views of the various disciplines represented in LeesEvolutie. It is the result of extensive input from the consortium members (through questionnaires, plenary meetings, multiple rounds of feedback on draft versions, and individual consultations), of a review of the research literature (including suggestions by consortium members), and of feedback from the advisory board. One of the striking results of the questionnaire is that consortium members differ greatly in how they view 'reading'. For example, some view reading as fluency–reading with proper speed, accuracy, and expression–, others as building a mental representation of the meaning of the text, yet others as interpretatively connecting the text to one's own identity. Other views were offered as well. The framework gives room to all these conceptualizations of reading. Together, the input from the consortium resulted in the identification of factors that contribute to reading, which are categorized and visualized as a planetary gear. One can use the framework to look from diverse perspectives at reading, for example by taking different factors in the gear framework as the starting/ending point or by focusing on different subsets of gears (e.g., the Approach to Reading gear and connected gears in relation to 'belezenheid/literacy'). Thus, the framework is inclusive of all disciplinary perspectives represented in the consortium.

The conceptual framework provides a common ground to the members of the LeesEvolutie consortium as well as to researchers and educators beyond the consortium. It also is the basis for a pedagogical-didactical framework and a data analytical monitor that focus on educational implications (WP 1b and 1c). Please note that the framework presents a *general* account of reading, that can be applied to reading in different situations and for different media. For each concrete reading situation and medium, the factors take on specific values and content. For example, with new technological functionalities and the affordances they present, a reader's interaction possibilities with text change. Before presenting the conceptual framework, we will first describe five important features of the framework to keep in mind while reading this document.

1. Important Features of the Framework

1.1 The Framework as a Planetary Gear: Identifying Pressure Points

The interplay of factors is visualized in the framework by means of a planetary gear (see Figure 1), representing five major sets of factors that constitute and influence reading. The visualization as gears highlights that the sets of factors only function in combination: By turning one gear, one automatically turns the others as well. Section 2 presents detailed descriptions of the framework as a whole and of each gear. Each description has a brief general introduction followed by an annotated list of factors within that gear. These factors significantly impact reading and a reader's knowledge and approach to reading (including motivational and orienting task aspects). Thus, the conceptual framework identifies a wide range of *pressure points,* that (a) have strong impact on reading and (b) effectively can be improved by targeted interventions. These pressure points are further developed in collaboration with WP 1b (educational framework).

Figure 1

Visual Overview of the Framework

1.2 The Collection of Gears

We aggregated the input provided by the consortium members into factors that could be grouped into five categories, reflecting the gears of the framework as visualized i. The *center gear* focuses on the cognitive and affective processes in the mind of a reader as he/she reads. The center gear is surrounded by three *intermediate gears* that reflect sets of factors that have a direct impact on processes in the center gear: (1) the input provided by the text (Text Characteristics gear), (2) the knowledge and experience a reader already has relevant to reading the text (Knowledge gear), and (3) the reader's approach to reading the text, including motivational aspects and orienting tasks (Approach to Reading gear). The *contextual gear* reflects powerful factors in the situational context in which an individual's reading and instruction takes place, such as parents/caregivers, teachers, didactical approaches, culture and society (including societal developments such as increasing digitalization, broadly in society and specifically in the educational system, school, learning, and home environment). These layers of gears represent micro-, meso-, and macro-levels, respectively. The use of a planetary gear highlights that influences flow in all directions. For example, they flow from the macro- to the meso- and micro-levels but also the other way around, from micro- to meso- and macro- levels. Thus, the gears and their factors are reciprocally related (see section 1.3).

1.3 Reciprocal Relations Between Factors

The multi-directionality of the constellation of gears in the framework captures how the flow of impacts can go in any direction. Processes in the center gear can be influenced through changes in factors in the intermediate gears and, indirectly, through changes in the contextual gear (via the intermediate gears). Conversely, many center-gear processes influence factors in the contextual gears. Similarly, factors in the intermediate gears can be influenced by factors in the contextual gear, such as teachers, parents/caregivers, and by factors in society at large. Thus, each gear encompasses pressure points that can affect factors in the other gears and, therefore, can be employed to improve the quality of important facets of reading.

1.4 (Intra-)Individual Differences

Individuals (and groups of individuals) differ in many respects that are relevant to reading. For example, they differ in the breadth and depth of their vocabulary, in knowledge of the topic of a text, in reading motivation, in their home environment, and so on. Similarly, differences within an individual occur from one reading situation to the next, for example because of different reading goals, motivation levels, fatigue, and so on. These and other differences between (groups of) individuals mean that factors in the framework take on different values and content for different individuals and, within an individual, across different reading situations. As a result, the implementation of the gears in the framework will vary, and different individuals (or the same individual in different situations) may arrive at different understandings and interpretations of the same text.

1.5 Time and Development: Reading and Education Change the Reader

The factors in the gears influence how a person reads a text but, importantly, the act of reading a text and the understanding and interpretation of the text that results—the reader's mental representation—also change the value and content of the factors for that reader. For example, the act of reading and understanding a text practices the cognitive and affective processes (center gear) and it also may influence the reader's motivation for future reading, the reader's self-perception as reader, and other factors captured in the Approach to Reading gear. Likewise, the understanding that results from reading a text may impact the reader's knowledge, from vocabulary to content knowledge about the text topic, from genre knowledge to knowledge about culture, beliefs and values (Knowledge gear). These are examples of how the reading of a text *changes the reader*. This reciprocity of influences adds the important dimension of *time* and *development* to the framework: The experience of reading, comprehending and interpreting a text will change the content and values of the factors in the framework. This, in turn, means that it changes the way the reader will process, understand and interpret subsequent texts (or even reread the same text; see the Outcomes application in section 3.3).

Texts differ in their impact, with some texts eliciting minimal changes, whereas other texts having more profound and lasting effects. This perspective emphasizes the role of education, which can direct the choice of texts and the reading experiences and, hence, how the reader changes as a person and as a reader.

2. Overview of the Conceptual Framework: A Planetary Gear with Interacting Factors

2.1 The Center Gear: The Reader's Cognitive and Affective Processes and Abilities

The center gear captures what happens in the mind of a reader *during* reading and how this affects what is in the reader's mind *after* reading. This can be directly influenced by factors captured in the intermediate gears, such as by characteristics of the text (Text Characteristics gear) which establish a scope of possible interpretations of the reading material, what knowledge a reader already has (Knowledge gear), as well as how the reader interacts with the text (Approach to Reading gear), and indirectly by the contextual gear (Reading Environment: Culture, Education, Home). Factors in the center gear are grouped in cognitive and affective processes related to the construction of a coherent mental representation of texts and general cognitive abilities of the reader.

2.1.1 Processes Related to the Construction of a Coherent Mental Representation of Texts

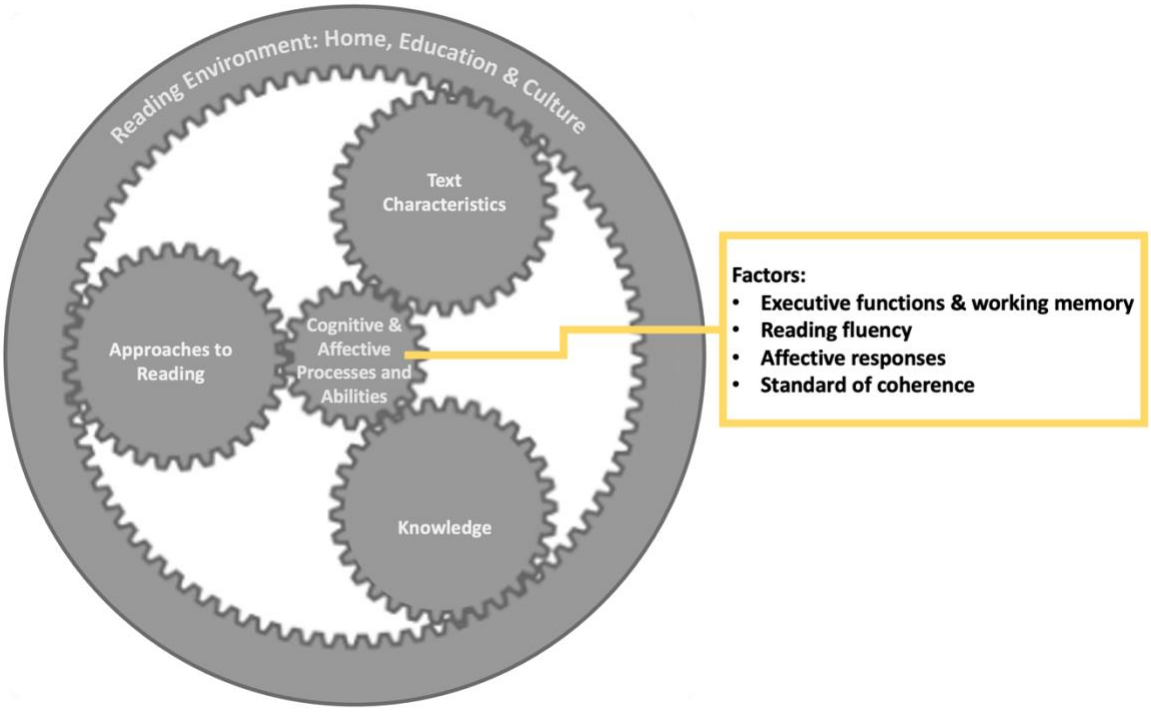
At the core of the center gear lies the construction of a mental representation of a text while reading a text. A reader constructs such a mental representation by connecting information from the text to what they already know, as well as by connecting pieces of information within the text (e.g., Kintsch, 1988; McNamara & Magliano, 2009). Readers do this through multiple, fast and overlapping processes such as activating the meaning of words, integrating them into the sentence structure while constantly updating the emerging text representation (Perfetti & Stafura, 2014). Some processes do not require effort by the reader, as they are passive and automatic (e.g., connecting the word “he” in a sentence to a male person mentioned earlier in the text).

Other processes require effort and are initiated by the reader, such as rereading parts of the text, or looking up unfamiliar words (van den Broek & Helder, 2017). Each reader has an (implicit or explicit) criterion (or *standard of coherence;* van den Broek et al., 1995) for what proper comprehension in a particular reading situation entails. If the passive, automatic processes do not satisfy the standard of the reader, the reader is likely to engage in the additional (effortful) reader-initiated processes. The outcome of the interplay between automatic processes and the orienting tasks initiated by the reader is the mental representation that captures the reader's cognitive and affective understanding and interpretation of what the text is about.

2.1.2 Factors in the Center Gear

Figure 2

Overview of Factors in the Center Gear



Executive functions and working memory (also referred to as cognitive control processes) are cognitive processes needed to control thinking and behavior. Holding information in **working memory** and updating its content can be regarded as one core component of executive functions and is important for reading because only with sufficient abilities to hold information can words, sentences or texts be processed to form a coherent mental representation. Other core components are *inhibitory control*, reflecting the ability to resist temptations and impulsive behavior (self-control) and to selectively guide attention to important information while ignoring other information (interference control), and *shifting/flexibility*, reflecting the ability to smoothly switch between tasks and adapt to changes in the environment. For an overview see Butterfuss and Kendeou (2018), and Diamond (2013).

Reading fluency refers to a reader's ability to read texts quickly and accurately and facilitates reading comprehension. It involves processes such as decoding of letters into sounds, rapid word identification and requires knowledge about, for example, letter-sound mappings, grammar and semantics (see factor about linguistic knowledge in Knowledge gear). For overviews see Fuchs et al. (2001) and Hulme & Snowling (2013). The more fluent a reader is, the more mental capacity she can devote to (deeper) comprehension (LaBerge & Samuels, 1974; Perfetti, 1985).

Affective responses during reading influence the construction of a mental representation of the text. For example, emotions experienced during reading can have an effect on what knowledge is activated during reading (Knowledge gear), or how likely a reader is to increase his or her standard of coherence (center gear). Another example is that readers can get absorbed and transported to a narrative world. Affective responses interact with the reader's norms, values, attitudes and expected outcome of reading (see Approach to Reading gear) and may have consequences for factors influencing future approaches to reading (e.g., readers' self-concepts). See Green et al. (2004) and Mar et al. (2010) for overviews.

Standard of coherence refers to the set of criteria that a reader (consciously or subconsciously) has about what constitutes good understanding in a particular reading situation. A reader's standard of coherence when reading a particular text is not an objective set of criteria but is the result of the individual reader's knowledge (including misconceptions or ideological biases; see Knowledge gear), values, attitudes, norms, self-concept, expectations, and specific reading goals (see Approach to Reading gear), the reader's cognitive and affective skills and processes (center gear), and the text itself and its possible interpretations (Text gear). Moreover, it usually is implicit, rather than something of which the reader is consciously aware. The standard of coherence (explicitly or implicitly) determines whether the reader feels that the comprehension that results from automatic reading processes is sufficient for understanding the text, or whether more supporting activities (i.e., reader-initiated processes, such as highlighting sentences or critically reflect on the text; see factor Orienting task in the Approach to Reading gear) are needed. For an overview see van den Broek & Helder (2017).

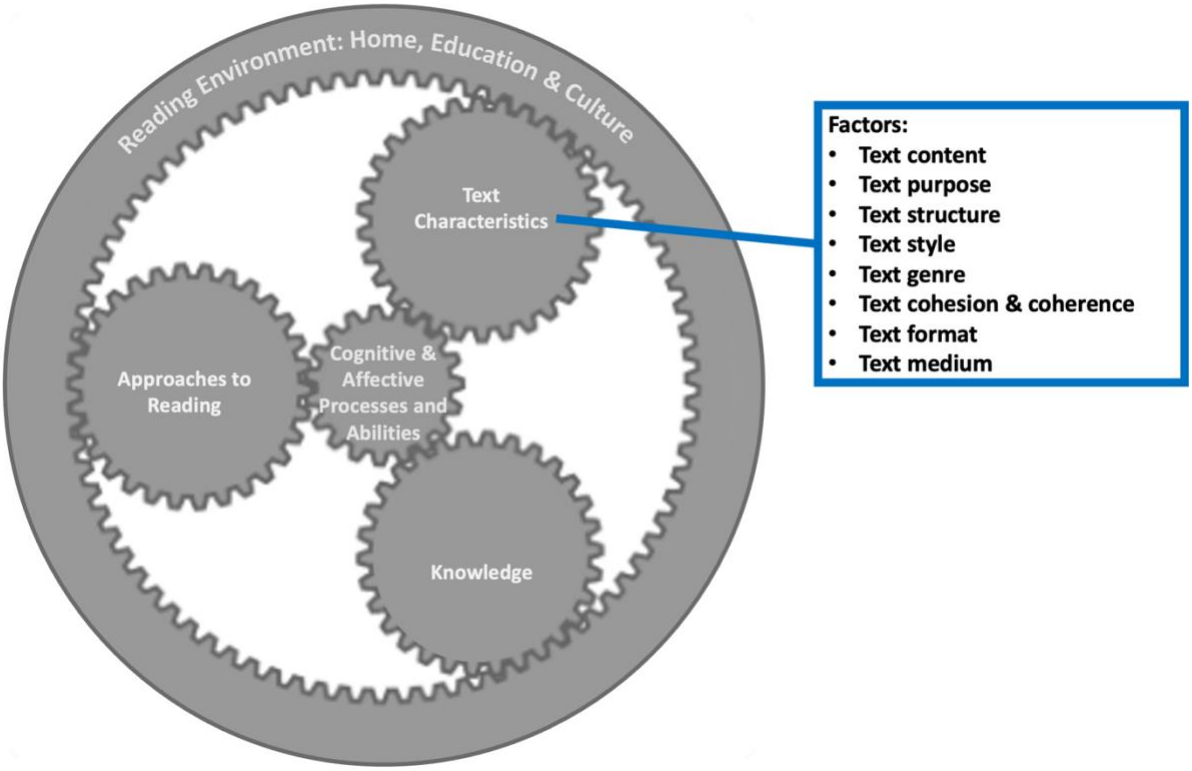
2.2 Intermediate Gear: Text Characteristics

The intermediate gear about the text characteristics captures factors connected to the text that is being read or offered. Those factors include characteristics of the content (e.g., topic, source credibility), the form (e.g., digital vs. analog, single vs. multiple texts), the genre (e.g., informative, narrative, poetry, fable, satire, brief message) and the style (e.g., formal, informal, humoristic). These characteristics create a scope of possible text interpretations (mental representations). They also influence the reader's criterion for when the text is sufficiently understood (i.e., standard of coherence; see the center gear) and whether adequate comprehension requires a specific approach to the reading (see the Approach to Reading gear). Conversely, the text selection (including its characteristics; see the Text gear) is influenced by the reading environment (culture, education, home environment; see contextual gear).

2.2.1 Factors in the Text Characteristics Gear

Figure 5

Factors and Pressure Points Related to Intermediate Gear: Text Characteristics



Text content refers to the discipline, domain, topic and information of a text, thereby providing the scope of possible mental representations a reader can construct of the text. The extent to which a reader is familiar with (parts of) the text content determines how easily a mental representation of the text can be formed and how likely it is that the reader will (effectively/deeply) engage with the text. See Goldman et al. (2016) and Shanahan & Shanahan (2012) for overviews.

Text purpose refers to the aim or intended objective that an author seeks to attain through the text. The aim of the text can provide the reader with clues about how to effectively process the text (e.g., critically evaluating arguments in a persuasive text). In the case of required reading (as in most educational settings), the purpose is determined by someone else (e.g., the teacher in educational settings). See Kalman et al. (2023) and Nelson et al. (2023) for overviews.

Text structure refers to the organizational pattern to arrange and present information in a text, such as the organization of ideas and the relations among these ideas, and the vocabulary used to express them. Common text structures (e.g., formats for description, sequence, enumeration, cause-effect, compare & contrast, problem-solution format) influence the formation of a mental representation of a text and the application of relevant reading tasks (see Approach to Reading gear). See Pyle et al. (2017) and Bogaerds-Hazenberg et al. (2021) for overviews.

Text style refers to a collection of means through which the meaning of a text can be conveyed in a particular fashion. Examples are the word choice (e.g., technical or academic terms in formal texts versus colloquial expressions in informal texts), sentence structure (e.g., length, type, or construction techniques), information density (e.g., dense information in technical texts versus sparse information in causal or narrative texts), register (e.g., informal or personal versus formal or business texts, depending on the audience or purpose), or choice of perspective (e.g., first person perspectives in personal narratives, second-person for instructional content, or third person for formal or objective texts). See Toolan (1996), Shelton (1994) and Bailin & Grafstein (2016) for overviews.

Text genre indicates categories of texts (e.g., narrative, expository, instructional, poetry, social media posts etc.) where texts within one category share conventions and features related to the intent of the communicator (e.g., instructional texts usually provide procedural steps on how to do something). Texts in the same genre thereby often share common characteristics in terms of content, style, form, and purpose. See Bawarshi and Reiff (2010), Stukker et al. (2024), and Renkema (2005) for overviews.

Text cohesion and coherence both indicate clarity and readability of a text but refer to distinct dimensions thereof. Cohesion refers to linguistic aspects of texts (and discourse), such as grammatical and lexical connections within a text (e.g., pronouns or conjunctions). Coherence refers to the (resulting) connectedness a reader establishes between ideas, sentences, and paragraphs in their mental representation of the text. Both cohesion and coherence facilitate the application of relevant orienting tasks (see Approach to Reading gear). See Givón (1993) and Sanders & Canestrelli (2012) for overviews.

The **text format** refers to how a text is presented (e.g., as static document or as an online document allowing the use of hyperlinks) and structured (e.g. headings, title, bullets, paragraphs, bold print, fonts, captions, etc.). Depending on the text format, all other inner gears can be influenced: The text format can

manipulate the presentation of the text materials (e.g., adding hyperlinks to a digital text) and influence the formation of a mental representation (e.g., through a font or text formatting coming with a medium). See Coiro (2021) for an overview.

Text medium refers to the way in which a text is delivered (e.g., a book, a piece of paper or a digital device, such as a phone, tablet or e-reader) and the affordances this offers (i.e., the possible use, function and purpose. The text medium and its affordances determine important factors in the reading experience, such as the set of possible text formats and the portability of reading materials (e.g. font/layout of the text on an e-reader and taking it on holidays), thereby also influencing a reader's approach to reading. See also section 3.5 about Reading in a Digital World and Singer & Alexander (2017) for an overview.

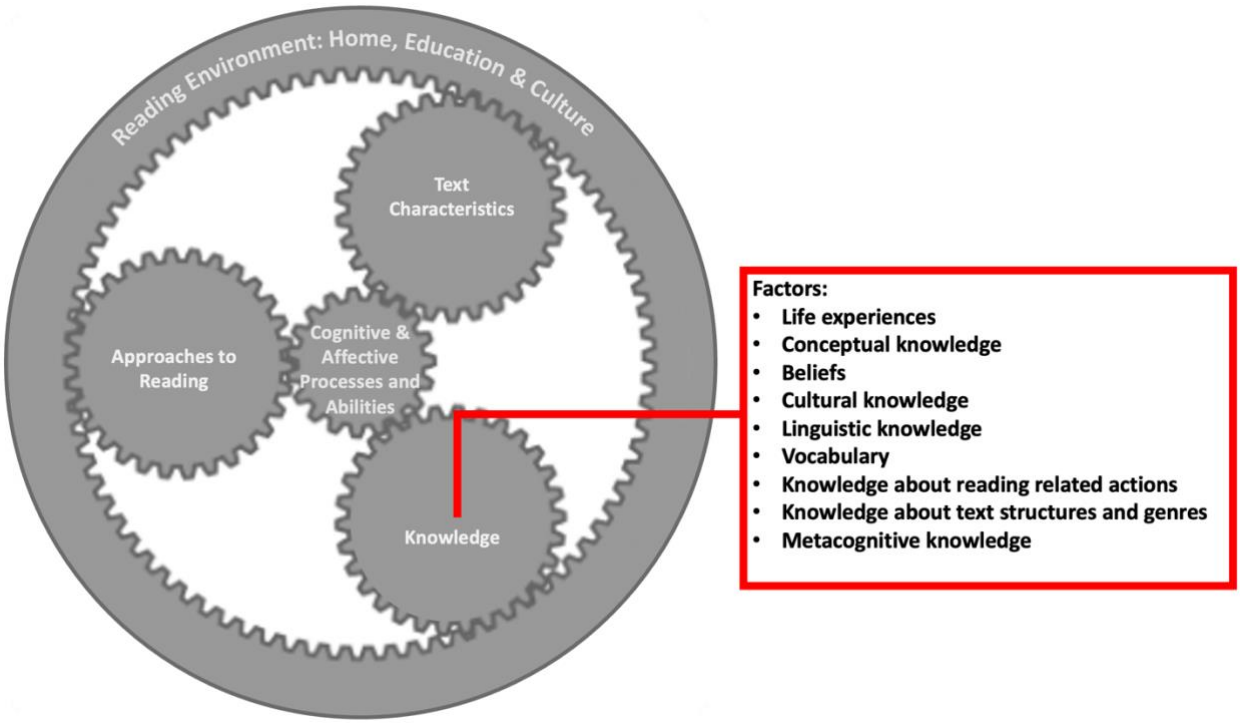
2.3 Intermediate Gear: Knowledge of the Reader

This intermediate gear captures different types of knowledge and experiences that influence the interplay of the text (characteristics) provided to a reader (in the Text gear), the cognitive and affective processes during reading (in the center gear), and the factors guiding an individual's approach to reading, such as motivational factors and orienting tasks (in the Approach to Reading gear). An individual's knowledge is influenced by factors in the environment (including Culture, Education, Home environment; contextual gear), and by the act of reading (center gear). Thus, knowledge contributes both to fluent reading and to comprehension and is enhanced by reading. For overviews of the different types of knowledge in the context of reading, see McCarthy and McNamara (2021), Hattan and Kendeou (2024) and Hatten, Alexander and Lupo (2024).

2.3.1 Factors in the Knowledge Gear

Figure 4

Factors and Pressure Points Related to Intermediate Gear: Knowledge of a Reader



Life experiences (including but not limited to reading experiences) refer to events and interactions that shape individuals and their understanding of the world. Relating (to) prior life experiences can for instance influence an individual's choice of literature and determine how they engage with a text (Approach to Reading gear) and facilitate the creation of a mental representation of a text

(cognitive processes in center gear). The texts that have been read (Text gear) further create new life experiences relevant for reading.

Beliefs in the context of this framework refer to different systems for abstracting types of knowledge to interpret reality. Examples are religious belief systems, philosophical belief systems, political belief systems, and personal belief systems (often based on other belief systems but unique to an individual). These belief systems can overlap and support each other, and they influence an individual's approach to reading (see Approach to Reading gear) as well as the cognitive and affective processes (center gear).

Cultural knowledge refers to a collection of understandings about values, customs, beliefs, and shared practices that a group or society holds, such as their historical perspectives, social norms, traditions, religious practices, culinary habits, interpersonal communication styles. The cultural knowledge of the reader influences the mental representation that the reader forms about a text as well as their approach to reading (e.g., through attitudes, values, norms and self-concept that developed as a function of the reader's cultural knowledge; see Approach to Reading gear). See Hammerberg (2004) for an overview.

Conceptual knowledge in the context of reading refers to a reader's prior understanding of ideas, principles, and relations between concepts that enable the reader to make sense of the text. For example, prior conceptual knowledge about thermodynamic principles will facilitate a reader's understanding of an expository text about the formation of thunderstorms. Conceptual knowledge therefore is essential for creating a mental representation about a text, for a deeper understanding of a situation, and for the capacity to reflect and properly analyze information of texts. See Smith et al. (2021) for an overview.

Vocabulary refers to knowledge of words. A distinction can be made between breadth and depth of vocabulary. Breadth of vocabulary refers to the quantity of words, that is, how many words a reader knows. Depth of vocabulary refers to the quality of the representation of words in a reader's mental lexicon, that is, how deeply a reader knows a word. The quality of the lexical representation of words has consequences for reading skill, including for comprehension: A high-quality lexical representation of a word facilitates rapid and accurate word identification and frees up mental capacity (working memory) for comprehension processes. See Perfetti (2007) and Swart & Verhoeven (2022) for overviews.

Linguistic knowledge refers to several types of knowledge that are needed for the fluent and accurate decoding of words in texts (see also reading fluency process in the center gear). These linguistic knowledge sources include, for instance, knowledge about grammatical rules and semantics (i.e., understanding of word meanings and their relationships within a particular language and context),

knowledge about letter (or symbol)-sound mappings and metalinguistic understandings about language practices. See Perfetti and Stafura (2014), and Clifton and Duffy (2001) for overviews.

Knowledge about text structures and genres refers to knowledge about how authors organize information within texts to convey their message. Knowledge about common text structures can help readers comprehend and analyze the texts efficiently (by applying useful strategies). See the Text gear for examples and Stukker et al. (2024) and Williams (2018) for overviews.

Knowledge about reading-related actions refers to the knowledge of a wide range of actions that the reader can take to help understand text (e.g., the inspection of headings and visual elements of the text, searching for the main purpose of the text and its intended audience, activating prior knowledge by linking previous experiences or similar texts to the present text topic, strategies to resolve problems the reader encounters or gain deeper understanding and reflection). This knowledge directs reader-initiated processes and includes knowing about (or having experiences with) such actions as well as about *when* to apply them (see center gear and Approach to Reading gear). See Dinsmore and Hattan (2020) for an overview.

Metacognitive knowledge refers to the understanding of one's own strengths and weaknesses for accurately planning, monitoring, evaluating and regulating thoughts and behaviors, both in the context of reading in general and in the context of reading a specific text. It contributes to decisions about what kind of reading related activities to apply in specific situations. See Thiede et al. (2009) and Zimmerman (2009) for overviews.

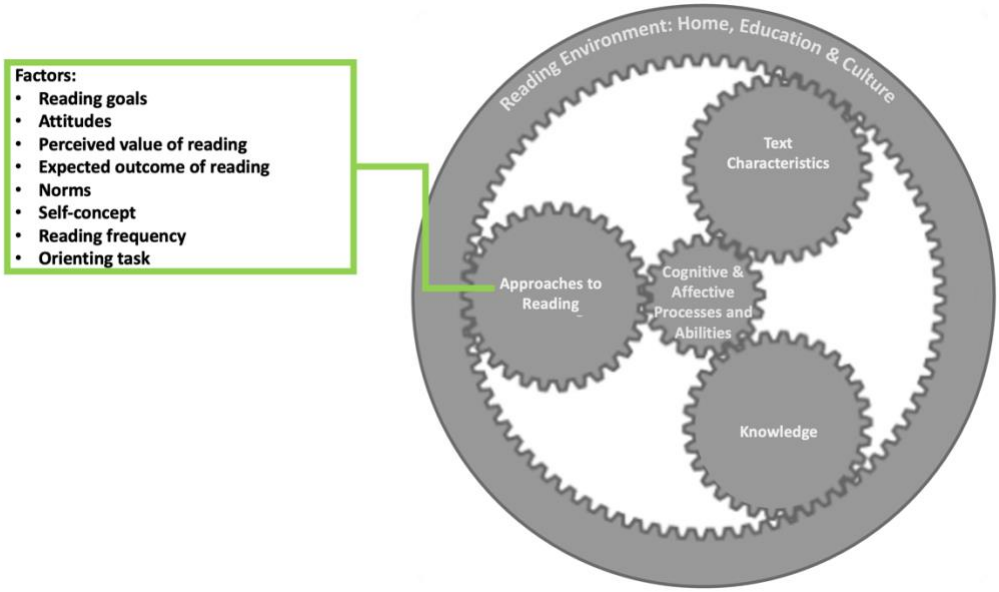
2.4 Intermediate Gear: Approach to Reading

This intermediate gear captures how a reader approaches a specific reading activity or task as well as how readers approach and perceive reading in general. The gear includes factors related to motivational aspects of reading as well as factors related to the reading task at hand. Please note that what the reading task is (e.g., what a teacher assigns) can be different from what the reader thinks the reading task is. Factors in this gear affect how and to what degree readers engage with a text to reach their individual and situation-specific criterion for understanding that text (i.e., standard of coherence; see center gear).

2.4.1 Factors in the Approach to Reading Gear

Figure 3

Factors and Pressure Points Related to Intermediate Gear: Approach to Reading



Reading goal refers to what the reader thinks the goal or the purpose of reading a text is. Examples are reading to obtain information, reading for study, reading for entertainment, reading for social connection (e.g., social interaction through chat conversations, sharing thoughts and opinions about texts/books with others). Reading goals influence the reader's standard of coherence in a specific reading situation and, consequently, the construction of mental representations of texts (see center gear). See McCrudden & Schraw (2007) for an overview.

Attitudes in the reading context reflect two dimensions of attitudes that can both influence and predict individuals' reading motivation and perceived task: Attitudes as an individual's stance towards reading or attitudes as an individual's stance towards a text topic. In both cases, these attitudes can be based on reasoning (cognitive attitudes), based on feelings or tastes (emotional attitudes), or

based on (convenient) habits (behavioral attitudes). Of those attitudes, emotional attitudes (e.g., feeling connected to a protagonist in a book or being interested in a text topic) are probably the most important as driving factors for reading motivation (i.e., the evaluation of whether to read or not). See Alexander and Jetton (1996), Petscher (2010), and Willingham (2017) for overviews.

Perceived value of reading comprises different types of values and costs of reading. Examples of values are the attainment and intrinsic value (referring to attitudes towards reading), and the utility value (referring to how useful reading is perceived for reaching current or future goals). Examples of costs are the time and effort required to read. See Wigfield & Eccles (2000) and Willingham (2017) for overviews.

Expected outcome of reading refers to individuals' beliefs about how successful they will be in performing the reading activity/task. Whether an individual decides to read is largely the result of the interplay of the perceived value of reading and the expected outcome of reading, see Wigfield & Eccles (2000) and Willingham (2017) for overviews.

Norms (in the reading context) can be regarded as specific operationalizations of values, as they often refer to – or justify - a specific underlying value. Norms can be *injunctive*, reflecting societal or group expectations towards reading (e.g., "you ought to read for school" or "you ought to join our online gaming session instead of doing homework", respectively) or reading skills (e.g., "after primary school you ought to be able to fluently decode a book"). Injunctive norms often are reinforced through social approval or disapproval. Norms can also be *descriptive*, reflecting readers' individual perceptions of how people surrounding them behave or what is typically done in a given situation (e.g., "we ought to do a lot of homework, but all my friends are gaming"). See Legros Cislaghi (2020) for an overview.

Self-concept of the reader refers to an individual's general perception and evaluation of themselves as readers (e.g., "I am a person who reads for pleasure") as part of their own identity. In this framework, self-concept includes self-efficacy as a more specific case of a reader's self-concept. Self-efficacy refers to readers' beliefs about their ability to read. Whereas self-concept is a rather stable construct across situations, self-efficacy can vary depending on the particular reading context or challenge. Compared to self-concept, self-efficacy beliefs are also more likely to change based on recent experiences or feedback. See Bong & Skaalvik (2003) for an overview.

Reading frequency refers to how often an individual read(s). This can be an individual's voluntary reading, for example leisure reading, but also obligatory reading, for example for school (see also definition/explanation of *reading goal*). Reading frequency contributes to the development of other factors in this gear (e.g., the development of attitudes, self-concept, or self-efficacy beliefs) and

expands a reader's knowledge (see Knowledge gear). An often-used proxy measure of past reading frequency is print exposure. See Mol & Bus (2011) for an overview.

Orienting task refers to the assignment that the reader has for during or after reading a text and that directs how the reader regulates the reading process based on the assignment. The assignment can be self-imposed (e.g., to learn something about X, to enjoy and relax) or it can be imposed by someone else such as by the teacher (e.g., to summarize, to compare and contrast, to reflect), and it can vary in complexity, from complex (e.g., requiring reflection or comparison) to simple (e.g., just to read the text, without having to do anything with the text), and everything in between. See Britt et al. (2017), van den Broek and Helder (2017), Broekkamp and Van Hout-Wolters (2007) and Winnie and Hadwin (2010) for overviews.

2.5 Contextual Gear: Sociocultural Reading Environment

The contextual gear captures the broader sociocultural environment in which reading and reading development take place. Factors in this contextual gear directly influence factors in the intermediate gears, which in turn modulate the processes in the center gear. Factors in the contextual gear include powerful influences from culture, education, and home environment, if the world surrounding the reader changes, parameters of the factors in the contextual gear also change.

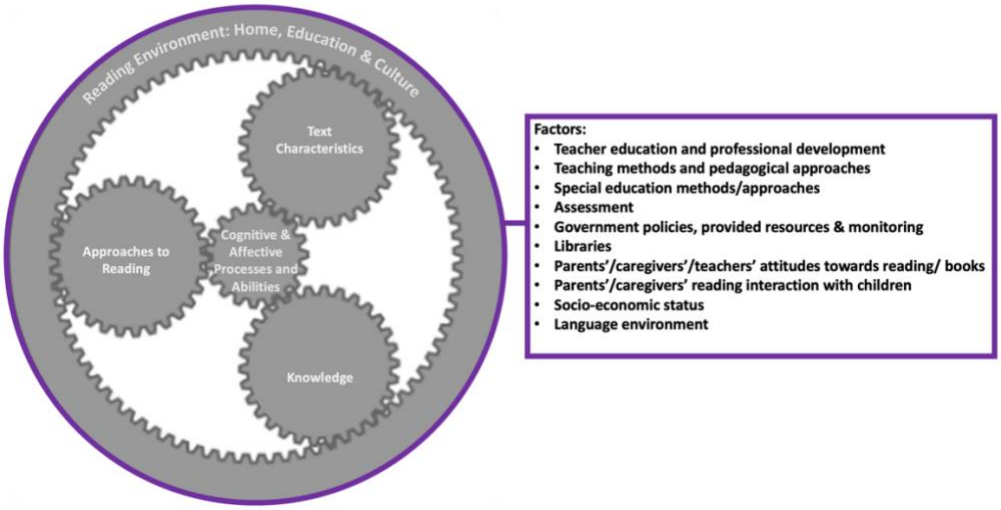
2.5.1 The Interplay of Culture, Home Environment and Education with Other Gears and Factors in This Framework

Culture influences most factors in the intermediate gears: It modulates values, norms, attitudes, and self-concepts of a reader, determines individual life experiences and other knowledge sources, provides a body of literature and influences the text a reader receives, and contributes to the education and home situation of a reader (e.g., through library access, language of instruction, or attitudes towards reading). Conversely, by reading individuals learn about the values, norms, and attitudes that the culture holds, embedding themselves in that culture and building a sense of identity. Culture exists at the national level but also at levels closer to the individual (e.g., subcultures, peers, etc.). Thus, reading is a cultural activity, not just because its development takes place through social interactions but also because texts reflect how a specific cultural group or discourse community interprets the world.

The education a child receives, and the child's home environment directly influence the Knowledge, Approach to Reading, and Text gears. They influence a child's exposure to reading and thereby influence reading development and behavior. Education, of course, is a powerful source of knowledge, skill development, exposure and (reading) experience, and provides an important connection between the other components of the contextual gear and the factors in the intermediate gears. In addition, education provides the mechanism by which society can stimulate the development of this knowledge, skills, etcetera.

Figure 6

Factors and Related to Contextual Gear: Culture, Education & Home Environment



2.5.2 Factors in the Contextual Gear

Teacher education and professional development ideally provides teachers with a foundation of evidence-informed knowledge and experience for designing and implementing good reading instruction that offers students a wide variety of challenging and rewarding reading experiences and fosters the development of reading skills. For instance, if primary school teachers know enough children's books to make individual reading recommendations to their students, while encouraging their students to read, discuss and reflect on the books, students are likely to read more often of their own accord and for their own enjoyment. Also, equipping teachers with evidence-based reading instruction methods can help them offer a wide variety of reading activities and prevent reading failure in their students.

Teaching methods and pedagogical approaches are the tools by which teachers can create an optimal learning/reading environment for their students.

Special education methods/approaches are specific tools and skills that teachers can employ to provide struggling readers (and more generally individuals with learning disabilities or disadvantages) with opportunities to develop their learning/reading in the best possible way.

Assessment includes summative, formative, and progress-monitoring tests. Ideally, tests are used by teachers and other professionals to assist them in making educational decisions aimed at maximizing the benefits of instruction for their students. The tests influence what teachers include in their lessons, through which methods, and in which time frame before the assessment.

Government policies, resources and external monitoring can influence reading and its multiple facets through requirements about reading performances at certain grade levels or literature. Available resources can further influence the school environment of a reader (e.g., more teachers, libraries, remedial programs) and national monitoring (e.g., Inspection) can contribute to an improvement or maintenance of the quality of reading instruction.

Libraries can ensure that families with low socio-economic status can offer enough reading experiences to their children. Libraries make books available but also organize activities to stimulate reading including preparing pre-school children for regular education (e.g., through activities for developing vocabulary) and remedying problems in language.

Parents'/caregivers'/teachers' attitudes towards reading/ books shape the approach to reading of the children under their care. For instance, the availability of a variety of books at home can increase the chances that children find reading materials that interest them; reading by parents/caregivers may stimulate the development of positive reading attitudes and perceived value of reading, which increase the likelihood of frequent reading

Parents'/caregivers' reading interaction with children (e.g., shared reading) influences many components of the children's knowledge (e.g., vocabulary, concepts, or text genres), particularly during preschool and beginning elementary school years. Furthermore, it may positively influence children's approach to reading by developing reading-friendly attitudes, values and norms.

Socio-economic status influences various aspects of the home environment that impact a child's opportunities for reading. Examples are the financial situation of a child's family, the educational background of the parents/caregivers, and the proximal neighborhood. These and other aspects can modulate factors related to the reader's approach to reading (e.g., value of reading), knowledge (e.g., vocabulary knowledge prior to reading), text input (availability of reading materials at home, or at a nearby library).

Language environment refers to the linguistic context in which a child grows up and lives outside of school. This context influences a reader's vocabulary and linguistic knowledge of Dutch and of other languages. For instance, a reader can have a large vocabulary in one language (e.g., the language spoken at home) but insufficient vocabulary to properly read in another (e.g., language of instruction). Conversely, proficiency in one language may facilitate development in another language.

3. Applications of the Conceptual Framework

The aims of the conceptual framework are to bring the diverse views on reading within LeesEvolutie together and to provide a tool for communication across the disciplines. The various disciplines differ in what they consider to be the essence of 'reading' and 'reading success' and in what they consider the major factors that influence reading and reading success. These divergent views on reading and reading success and on major influences on reading all are represented in the conceptual framework. Because it is a general framework aimed at facilitating communication, some important aspects of reading that are relevant for the aims of LeesEvolutie are implied in the framework but easily may be missed. Here, we elaborate on some of these aspects, including (1) the interactivity between factors in different gears, (2) the interaction between factors for children at different ages/skill levels, (3) the outcomes of the reading process, (4) the reciprocal relation between the socio-cultural context of the reader and reading, and (5) reading in a digital world.

3.1 Interactivity Between Factors in Different Gears

A key feature of the framework is that it emphasizes that factors interact in their effects on reading and reading development. One factor may facilitate another factor, one factor may be a precondition for another, they may compensate, and so on. Interactions between important factors *within* each gear are relatively easy to imagine, but interactions between important factors in *different* gears may be harder to envision. Therefore, it may be helpful to consider a few concrete examples of such between-gear interactions.

Example 1. Interaction between factors in the Text, Approach to Reading, and Knowledge gears. When a reader reads a text about mussels (text content, factor in the Text gear), with the goal of learning more about life in the North sea (reading goal, factor in the Approach to Reading gear), the reader draws on his/her experience of eating mussels or finding shells of mussels at the beach and on knowledge about sea biology or molluscs (life experiences and conceptual knowledge, factors in the Knowledge gear) to interpret the text (mental representation construction, factor in the center gear). It also works the other way around: The memory of eating mussels with family (life experiences) may trigger the reader to learn more about sea life (reading goal) and to find and read texts about mussels (text content).

Example 2. Interaction between factors in the Knowledge, contextual, Text, and Approach to Reading gears. A child believes eating genetically modified food causes health problems and is bad for the environment (conceptual knowledge, factor in the Knowledge gear). At school, the child's biology teacher stimulates her students to find articles about the benefits of genetically modified food for health and environment (teachers' attitude towards reading, factor in the contextual gear / text purpose, factor in the Text gear). The outcome is that the child revises his/her knowledge (conceptual knowledge) and

realizes reading texts from different sources can be helpful in shaping accurate knowledge (attitude towards reading, factor in the Approach to Reading gear).

Example 3. Interaction between factors in the Approach to Reading gear and the center gear. Two readers read a text about the description of a house with single-glazed windows. Reader 1 reads the text from the perspective of a home buyer, reader 2 reads the text from the perspective of a burglar (reading goal, factor in the Approach to Reading gear). The readers construct different meanings of the text (mental representation construction, factor in the center gear): For example, Reader 1 focuses on the potential heat loss of the house, whereas reader 2 focuses on how easy it is to enter the house from the old windows (this example is based on Pichert & Anderson, 1977).

3.2 The Interaction Between Factors Between Children at Different Ages/Skill Levels

The interaction between factors in the conceptual framework depends on the reader's age and skill level and therefore it is important to consider these factors from a developmental perspective. Specifically, the influence of one factor on another may change over time as the reader grows older and gains more experience. At different ages/skill levels, a factor may wax or wane in the strength of its causal relation to reading processes and performance. Consequently, teaching methods and pedagogical approaches (a factor in the contextual gear) differ between primary and secondary education. Below, we discuss three examples of key developmental aspects that should be considered when examining how factors in the conceptual framework interact: (a) reading skills develop and become automated with age and practice, (b) reading skills develop against the backdrop of developing executive functions and working memory, and (c) external influences such as the roles of parents, teachers and peers change with age.

(a) Reading skills develop and become automated with age and practice. As children develop reading skills, they gradually transition from learning to read to reading to learn. An important aspect of this transition is the ability to read fluently, that is, to decode and identify words quickly and accurately, without much effort. Typically, the automatization of decoding skills occurs through consistent practice and exposure to increasingly complex texts. As decoding becomes more automated and therefore require less effort, more mental capacity can be allocated to comprehension processes.

(b) Reading skills develop against the backdrop of developing executive functions and working memory. The development of reading skills should be considered in the context of the maturation of executive functions and working memory, which improve substantially during childhood and adolescence (Gathercole et al., 2007; Luna et al., 2004). The development of executive functions such as inhibitory control and cognitive flexibility is supported by structural and functional brain changes (e.g., Luna et al.,

2015). As readers' cognitive capacities increase, they facilitate the ability to manage increasingly complex reading tasks.

(c) External influences change with age. Throughout development, the roles of other people—such as parents, teachers, and peers—shift significantly. In early childhood, parents and caregivers play a dominant role in a child's literacy development through shared reading and by modeling reading behavior. As children enter school, teachers become primary facilitators of reading skills. During adolescence, peer interactions play a major role in shaping literacy practices and attitudes.

3.3 The Outcomes of the Reading Process

The primary outcome of the implementation of the planetary gear during reading of a particular text is that the reader constructs a mental representation of what the text is about. It is constructed through the cognitive and affective reading processes that take place as the reader engages with the text (the center gear), bringing together the information in the text, the reader's knowledge/beliefs, and the reader's approach to reading this text (the intermediary gears), Thus, the reader's mental representation captures the reader's comprehension of the text. However, there are also other outcomes because the mental representation changes the content and values of factors in the intermediate gears and possibly even in the contextual gear. These broader outcomes mean that the reader has changed and will read new texts differently than if the reader had *not* read this text (see section 1.5 in the introduction).

For example, reading a text about how mussels have an important water-filtration function because they absorb the dirt they process into their organisms, modifies the reader's conceptual knowledge about mussels (Knowledge gear). The reader will now comprehend subsequent text about the presence of microplastics in mussels and understand the implications more easily. Likewise, reading the text may result in greater interest in reading other texts (Approach to Reading gear) and even inspire beliefs about values and norms (contextual gear). Thus, the implementation of the planetary gear when reading a particular text has an immediate outcome (the mental representation that capture understanding) and broader outcomes that potentially alter the reader's skills, knowledge, beliefs about reading, and the world (changes in the intermediate and contextual gears).

3.4 The Reciprocal Relation Between the Socio-Cultural Context of the Reader and Reading

The factors of the Knowledge and Approach to Reading gear keep developing throughout the life of a reader (within and outside of the reading context) making the specific values and content of the factors unique for every individual and every situation. Because of this individual development of the factors and the way the factors determine how the reader interprets a text, the process of reading cannot be seen independently of the socio-cultural context of the reader. For example, imagine a situation where

two readers, one with a Christian and another with a Buddhist religious belief system (see Knowledge gear) read a quote of Mahatma Gandhi, saying: “Birth and death are not two different states, but they are different aspects of the same state.” The reader with the Christian belief system might interpret the text in such a way that life is a continuum under God's authority, meaning that the physical death transitions a believer into eternal life with God. The Buddhist might interpret the text in the sense of reincarnation on earth itself, in line with the concept of saṃsāra, the endless cycle of birth, death, and rebirth driven by karma. The two different interpretations of the same quote mainly stem from the different religious beliefs of the readers (see belief factor in the Knowledge gear), which developed in the context of the readers’ social upbringing and surrounding, as well as their broader cultural context.

The socio-cultural context of a reader also influences the factors in the Text gear by guiding the exposure to text characteristics (e.g., genres and text mediums; see Text gear). For example, a child growing up in a family where the only book that is being read is a religious book (e.g., the Bible or the Koran) will be exposed to other words and texts than a child growing up in a family reading a lot of science fiction books. Likewise, a child growing up in the Netherlands is more likely to read digital texts on a phone, tablet or e-reader than a child growing up in a rural area without any internet infrastructure.

3.5 Reading in a Digital World

Reading and reading education increasingly occur in a digital context. On a fundamental level, the cognitive and affective processes and abilities described in the conceptual framework are not dependent on whether a text is presented in a digital context or not. However, the digital context influences the particular form that many factors in the framework take. Importantly, these influences change as the digital world evolves (e.g., the further development of generative AI). The digital context provides unique affordances, presenting both opportunities and challenges to readers and reading education. These affordances may affect many factors involved in reading. They can be divided roughly into effects of (a) the quantity and quality of the information that is available on the internet, (b) the use of digital software in reading and reading education, (c) the hardware properties of a digital device and (d) the digital medium as a social context for reading. A few examples of each are given below. These sets of affordances are of course not mutually exclusive but partially overlap and interact. For readers to take advantage of the opportunities and overcome the challenges posed by these affordances they need to have skills and strategies specific to the digital world.

(a) The quantity and quality of information on the internet. The internet offers readers unique opportunities to access rich information and acquire new knowledge but also presents a more complex environment than the traditional reading environment in which printed texts are read. Texts that are digitally available frequently contain *links to other texts or other media* that may support and deepen comprehension, that allow comparison of viewpoints on an issue, that are loosely associated to the

starting text, and so on. This also means that *multiple texts* are frequent and that these can be arranged in ways not typically found in print texts (e.g., sequential vs. hierarchical). Beyond *quantity* and *complexity*, the available reading materials also vary in *quality* and *reliability*. Thus, reading in a digital world requires the same skills and strategies used in comprehending printed texts, as well as more complex s*kills and strategies specific to online reading*. These skills and strategies include *selection* (e.g., what prompts to use, which links will I follow, what texts are relevant?), *navigation* (e.g., where am I in reading the texts I want to read, what was my starting point?), *evaluation* (e.g., are these texts reliable or fake news, what is the authority of the source/author?), and *integration* (e.g., how to bring together the encountered information from multiple sources into a coherent interpretation and understanding?). For an overview see Salmeron et al. (2018). These skills and strategies are even more important in the context of generative AI, which purports to relief the reader from the need to select, navigate, evaluate and integrate.

(b) The use of digital software in reading and reading education. Digital tools can be used to expand reading education. First, devices may make texts more *accessible*. For example, e-readers and other digital devices are portable (e.g., on holidays, between school and home) and allow students to highlight and annotate, to look up the meaning of difficult words, look for a similar text, and so on. They also have *functionalities* that printed texts do not have, such as playing texts as audiobooks and including media other than just text (e.g., for stimulating interest in a book series or building up the vocabulary of a beginning reader). Second, software may *facilitate reading development* as it trains, monitors, tests or supports the reading process of an individual. Examples are games or intelligent tutors stimulating and practicing reading and/or spelling, apps or dashboards that monitor reading activities in a digital learning environment, and *digital testing tools* to facilitate targeted diagnostic tests as well as large scale tests for many students/respondents, potentially with automatic response evaluation/scoring. Third, online platforms/social media facilitate *collaborative reading* among students, such as reading together, making assignments together, having discussions, and so on. It also allows students to *connect to reading communities* with reading influencers, book recommendations, online book clubs, and other ways of bringing together people with a shared literacy interest. At the same time, social media, messaging tools, or other sources of notifications potentially distract the (digital) reading process (see below). Fourth, *generative AI* presents new, powerful affordances for reading and reading education. On the one hand, it poses a challenge to a reader's independent and critical thinking. On the other hand, it may provide unique opportunities for strengthening (reading) education (e.g., AI Leap https://www.aileap.ee/en).

(c) *The hardware properties of a digital device.* As mentioned, *portable* digital devices allow access to books, newspapers and other textual materials virtually everywhere and at any time. In addition, digital devices display texts in different ways (from each other and from paper). For example, most digital devices can be *personalized to the needs of the individual reader*, by changing font size, spacing,

brightness, and so on, thereby facilitating reading. The *physical properties* of a digital device may also influence the reading experience, although research shows that differences are rather small (for an overview see Salmerón et al., 2024). Printed text particularly affords reading of single texts. Here, reading on paper shows a slight advantage over reading on a laptop but only for single, long informational texts and under time pressure. There are no differences for reading narratives or for reading on e-readers (Schwabe et al., 2022). Reading in a digital context has particularly strong affordances when it comes to reading of *multiple texts* and reading of texts with *complex (e.g., interleaved or hierarchical) structures.* In the past 5-10 years, there has been a considerable amount of research on reading of multiple texts (Barzilai et al., 2018) and of texts with complex structures (Bruggink et al., 2025). Likewise, valuable insights recently have been gained on readers' ability/difficulty to assess source quality (Brante & Strømsø, 2018).

(d) ***The digital medium as a social context for reading.*** Digital devices often are used for other purposes besides reading, for example as a social medium. On the one hand, this affords unique educational applications. For example, as indicated above, online platforms/social media may facilitate *collaborative reading* activities among students, such as reading together, making assignments together, having online discussions, and so on. On the other hand, functionalities such as social media, messaging tools, or other sources of notifications may *interrupt* reading and *interfere* with attention and comprehension, especially when the reading takes place on the same device. There is some suggestion—although no solid proof—that even if the other purposes are blocked, the association of the device with these purposes may affect reading.

4. Conclusion

The aims of the framework are to bring interdisciplinary perspectives together and to provide both a common ground for the different research disciplines within the LeesEvolutie consortium and to capture the richness and complexity of reading and reading instruction. It highlights that reading among youth is the emergent property of a complex system of interacting elements operating at different levels (individual, interpersonal, educational, organizational, social, environmental, economic, technological, political). The functioning of the system reflects the dynamic interactions between these elements. Yet, to facilitate the use of the framework for communication amongst disciplines, the framework is kept relatively simple and coarse grained, taking into account only the most relevant factors reported through research and practice. Therefore, it is the result of a balancing act between detail and completeness, a simplification of the complex, multifactorial process of reading that can be elaborated according to specific research or practical purposes.

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