Learning to read and write

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Introduction

The ability to read and write is the backbone of daily functions and learning in contemporary society. Reading and writing involve highly complex workings of the human mind (Huey, 1968) and develop through interactions between individual characteristics (e.g., language and cognitive skills and knowledge) and multiple layers of environment such as the language and literacy environment in the home, formal instruction, and larger systems (e.g., state or national policy; Joshi and Aaron, 2012; Kim, 2020a). In this chapter, I review the knowledge and skills that influence development of reading and writing skills, respectively. This is followed by a review of reading-writing relations and the nature of structural relations among contributing skills, reading, and writing skills, such as hierarchical, interactive, and dynamic relations. Practical implications are also discussed.

Knowledge and skills that influence reading development

Reading comprehension involves visually perceiving letters and words, converting them into speech sounds (decoding), parsing linguistic information, developing initial understanding of propositions based on the given information, and integrating propositions for an accurate and coherent mental representation (see Kintsch, 1988; Snow, 2010 for different levels of mental representations and comprehension). Decoding or word reading skills are absolutely necessary for reading comprehension as reading involves written texts. Word reading processes draw on the knowledge of orthographic symbols (orthographic awareness; e.g., knowledge of alphabet letters and their sounds), speech sounds represented in words (phonological awareness), and morphological structure (morphological awareness; Foorman et al., 2016; National Institute of Child Health and Human Development [NICHD], 2000; Snow et al., 1998).

Writing systems represent oral language in various ways where orthographic symbols represent either speech sounds or meaning (see Kim, 2022a). The vast majority of the writing systems in the world employ an alphabetic writing system where orthographic symbols represent sounds. English is an example of an alphabetic writing system. In English, the Roman alphabet letters are used as orthographic symbols that represent the smallest unit of speech sounds, phonemes. For example, the word *dog* has three letters, *d*, *o*, and *g*, each of which represents associated sounds /d/ /ɔ/ and /g/. The three letters, *dog*, are not a single unit that represents the syllable of /dɔg/ or the meaning of a dog. Various orthographic symbols are used in alphabetic writing systems (e.g., Hangul in Korean, Cyrillic in Russia and other countries), but the principle is the same. Orthographic symbols do not always represent phonemes. In Japanese Hiragana and Fidel in Ethiopia, orthographic symbols represent syllables. For example, く in Hiragana represents the /ku/ syllable, and is not a combination of two parts that respectively represent /k/ and /u/ phonemes. In contrast to alphabetic writing systems, Chinese has a meaning-based writing system, called a morphosyllabic writing system where each character represents a meaning unit, morpheme, and a sound unit, syllable, simultaneously (see DeFrancis, 1984 for details about the Chinese writing system).

In languages with alphabetic writing systems, learners need to know orthographic symbols and their associated sounds (orthographic awareness; e.g., letter *d* represents /d/). Learners also need to develop an understanding of the sound structure of a language, phonological awareness, because sounds map onto graphemes (letters or groups of letters). Essentially, learners need to develop an understanding of the alphabetic principle (orthographic symbols represent speech sounds) and grapheme-sound correspondences (mapping of letters or combinations of letters to sounds). Learners also need to understand morphemes and their representation in spelling. Morphemes are the smallest unit of meaning, such as plural -*s* (e.g., *dogs*) and affixes (e.g., *un-* [*undo*]). In many alphabetic writing systems, spellings of words do not represent speech sounds alone, but represent morphological information as well (this is called a morphophonological writing system). For instance, the word *sign* has *g* although it is not pronounced because the word *sign* is morphologically related to *signal*. Meaning information, in addition to phonological information, is preserved in word's spelling. Overlay of meaning on speech sound information frequently causes mismatch between

word's spelling and speech sounds, creating difficulty in decoding and spelling. For example, the words *electric* and *electricity* retain the same spelling *c* despite changes in the sound (/k/ and /s/). Therefore, an understanding of morphological composition of words, morphological awareness, helps word reading and spelling especially for multimorphemic words (Joshi et al., 2008–2009; Kim et al., 2013).

The consistency between graphemes and sounds influences the learning rate of word reading. Word reading acquisition is faster in languages with consistent mappings of graphemes and sounds (transparent orthography; e.g., Finnish, Italian, Spanish) than in languages with inconsistent mappings (opaque orthography; e.g., English). For instance, students learning to read in transparent orthographies reach over 90% accuracy of word reading after 1 year of reading instruction whereas students learning to read in opaque orthographies take 2.5 times longer to reach a similar level of proficiency (Seymour et al., 2003). Writing systems also influence the extent to which word reading and spelling draw on phonology, orthography, and morphology (Katz and Frost, 1992; Kim, 2020a; McBride-Chang et al., 2008; Ziegler and Goswami, 2005). In transparent orthographies, orthographic awareness and phonological awareness are key determiners of word reading and spelling skills whereas in opaque orthographies, morphological awareness plays an important role (e.g., McBride-Chang et al., 2008). Furthermore, in orthographies with high visual complexity (e.g., Chinese), visual processing is of great importance (Zhou et al., 2014).

During the initial phase of word reading development, decoding is a slow process of mapping graphemes to sounds and assembling sounds to pronounce a word. With practice, word reading becomes accurate and rapid, i.e., fluent word reading. Fluent word reading is instantaneous recognition of words as a whole without a slow decomposition process (recognizing a single word instantaneously; Ehri, 2005). It is also important to develop fluent reading of connected texts. This is referred to as text reading fluency or oral reading fluency—the skill to read connected texts accurately and rapidly with expression (NICHD, 2000). Text reading fluency facilitates reading comprehension as the reader is no longer limited or constrained by word reading and thus can focus on understanding the meaning of the text (Jenkins et al., 2003; Kim, 2015a; LaBerge and Samuels, 1974).

While word reading skill is necessary for reading comprehension, it is certainly not sufficient. Comprehension is a highly complex construct and requires an array of knowledge and skills: knowledge of the meanings of individual words (vocabulary) and chunks of words (syntactic knowledge); the ability to reason and infer unstated information (inference), monitor one's own understanding (comprehension monitoring), and employ appropriate comprehension strategies; knowledge of a given topic (topic knowledge); knowledge of discourse features (e.g., text structure); and domain-general cognitive abilities such as working memory and attentional control (see Cain and Oakhill, 2007; Kim, 2020a,b). Reading skills also interact with social-emotional aspects toward reading (e.g., attitude, motivation, anxiety; Kim, 2020a,b), and text features (Francis et al., 2018; Kim, 2020a,b). Reasoning and inference are broad constructs that include multiple aspects and types. For example, inference includes inferring spatial relations among entities, referents of nouns and pronouns, causal structure of propositions, and understanding perspectives (characters', authors', and the reader's own perspective; Graesser et al., 1994; Kim, 2020a,b; Shanahan et al., 2010). Texts in general do not explicitly state all necessary information for comprehension, and therefore, inferring unstated information is part and parcel of establishing coherent understanding of text.

A vital point that is often not well recognized is that comprehension skills initially develop in the oral language context (listening comprehension) and continue to develop in the written language context (reading comprehension). Listening comprehension is a skill to comprehend oral texts, such as stories, multi-utterance conversations, and oral informational texts (e.g., watching or listening to a segment on life cycles of an animal; Kim, 2015b, 2016; Kim and Pilcher, 2016). The above noted skills and knowledge such as vocabulary, background knowledge, and inference are all utilized in listening comprehension (e.g., Florit et al., 2014; Kendeou et al., 2008; Kim, 2016; Kim and Phillips, 2014; Tompkins et al., 2013) and continue to be used in reading comprehension (e.g., Cain and Oakhill, 2007). Put simply, reading comprehension is listening comprehension with additional word reading processes (Gough and Tunmer, 1986), and word reading and listening comprehension, respectively, involve multiple skills and knowledge described above (see the direct and indirect effects model of reading; Kim, 2017, 2020a,b).

Word reading and its component skills (orthographic, phonological, and morphological knowledge) have a large influence on reading comprehension in the beginning phase of reading development whereas listening comprehension and its associated skills and knowledge (e.g., background knowledge, vocabulary, inference) exert increasing influence as word reading skill develops (Kim, 2020a,b). For example, on average, in lower elementary or primary grades, one's word reading skill primarily determines their reading comprehension (Kim, 2015a; Kim and Wagner, 2015). In contrast, by middle school, listening comprehension skill primarily determines reading comprehension performance for the majority of students (e.g., Adlof et al., 2006). Regardless of grade level, however, for students who struggle with word reading, their inadequate word reading skill limits reading comprehension.

Knowledge and skills that influence writing development

Writing requires something to write about, i.e., idea generation. Generated ideas need to be translated or expressed into words and sentences. Translated ideas then need to be converted to printed words and sentences (encoding or transcription). Drafts are revised for expression, cohesion, and coherence, and edited for writing conventions (Hayes and Flower, 1980). These writing

processes draw on a number of skills and knowledge. Idea generation requires world, topic or content knowledge or reading skills. Translation into words and sentences draws on oral language skills. Appropriate and precise use of words and sentence structures is necessary for conveying thoughts accurately, and this requires oral language skills such as vocabulary, morphosyntactic, and syntactic knowledge (assembling words to construct phrases and sentences). The encoding process requires transcription skills such as spelling and handwriting or keyboarding, which place a large constraint on the writing process (Abbott and Berninger, 1993; Graham et al., 1997; Santangelo and Graham, 2016). Spelling draws on the same skills as does word reading—that is, orthographic awareness, phonological awareness, and morphological awareness (Apel et al., 2012; Kim, 2020a; Kim et al., 2013; NICHD, 2000; Snow et al., 1998). Handwriting or keyboarding requires motor skills and orthographic awareness (Berninger et al., 1992).

A quality written composition is more than an assembly of accurately encoded words and sentences. Sentences and ideas should be semantically related and be arranged in a logical order, and the text as a whole should be globally coherent and aligned with the writer's intended meaning. The writer needs to decide what information to present explicitly versus suggest implicitly, arrange sentences for a logical flow of ideas, and determine how to express and present ideas for the presumed audience and their needs. The writer also needs to monitor one's own writing process and be able to employ necessary strategies (e.g., using graphic organizers for planning, or using a writing checklist; Graham et al., 2012, 2016; Kim, 2020c). All these require higher order cognitive skills, such as reasoning, inferencing, and perspective taking (Kim, 2020c; Kim and Park, 2019). In addition, the writer needs to know and employ genre conventions such as text structure and associated linguistic features. Narrative texts typically include characters, a setting, a series of events, problems, and resolutions. Informational texts have different subtypes such as persuasion, opinion, compare-contrast, and description, and each has its own prototypical structure. Therefore, the writer needs to select the appropriate text structure for a given goal using their discourse knowledge to effectively convey ideas (Kim, 2020c; Kim and Park, 2019) because readers find it difficult to comprehend texts that do not follow conventional structures (Meyer, 1975). The writing process and the component skills that contribute to the writing process also require domain-general cognitive skills such as working memory and attentional control (Kellogg, 1996; Kim and Park, 2019; Kim and Schatschneider, 2017). Furthermore, writing skills interact with socio-emotions toward writing (e.g., motivation, attitude, interest, anxiety, self-concept; Graham et al., 2007).

The relations of component skills to writing change depending on the phase of writing development. In the beginning phase of writing development, transcription skills (spelling, handwriting, keyboarding) severely constrain the writing process, whereas other skills and knowledge (background knowledge, higher order cognitions, oral language skills) increasingly influence written composition as transcription skills develop (Kim and Graham, 2022; Kim and Park, 2019). Furthermore, writing develops from knowledge-telling to knowledge-transforming to knowledge-crafting phases (Bereiter and Scardamalia, 1987; Kellogg, 2008). In the beginning phase of writing development, writers tell what they know (hence, knowledge-telling). Writing during this phase is essentially a process of retrieving knowledge from long-term memory and transcribing it into a written product. In the knowledge-transforming phase, writing reflects the writer's thought process and "becomes a way of actively constituting knowledge representations in long-term memory" (Kellogg, 2008, p. 7). The knowledge-crafting phase is when professional expertise in writing is achieved. In this phase, the writer coordinates author, text, and reader representations and crafts writing with the potential reader in mind.

Reading and writing relations

A robust body of literature indicates that reading and writing are not independent, but instead they are related. A recent meta-analysis found that word reading and spelling are strongly related ($r = 0.82$) and that reading comprehension and written composition are moderately related ($r = 0.48$; Kim et al., 2022). One potential reason for reading-writing relations is that many tasks and activities require use of reading and writing skills simultaneously (e.g., writing a book report, writing a grocery list and reading it), and therefore, reading and writing skills are functionally related (Langer and Applebee, 1987; Shanahan, 2016). Another explanation for reading-writing relations is that reading and writing draw on shared skills and knowledge. In other words, highly similar skills and knowledge underlie reading and writing, and consequently reading and writing are related. A heuristic representation of this idea is illustrated in Fig. 1: Reading and writing skills may appear distinct at the surface; however, they are products supported by shared underlying language and cognitive skills that may not be readily visible (Kim, 2020d).

The idea that reading and writing are built on highly similar skills and knowledge was described in the shared knowledge hypothesis (Fitzgerald and Shanahan, 2000). According to Fitzgerald and Shanahan (2000), shared knowledge between reading and writing include (a) metaknowledge about functions and purposes of reading and writing, monitoring one's own meaning-making and word identification or production strategies, and monitoring one's own knowledge; (b) domain knowledge about substance and content, which includes vocabulary and meaning created through context of connected text; (c) knowledge about universal text attributes, including graphophonics (phonological awareness, grapheme awareness, and morphology), syntax (syntax of sentences and punctuation), text format (text structure, and organization); and (d) procedural knowledge and skill to negotiate reading and writing, such as knowing how to access, use, and generate knowledge, and smoothly instantiate various processes.
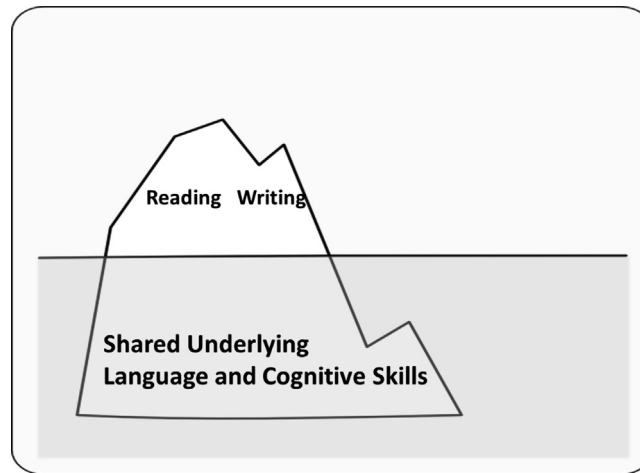
Fig. 1 A heuristic for reading-writing relations and their shared language and cognitive skills. Reproduced from Kim (2020d).
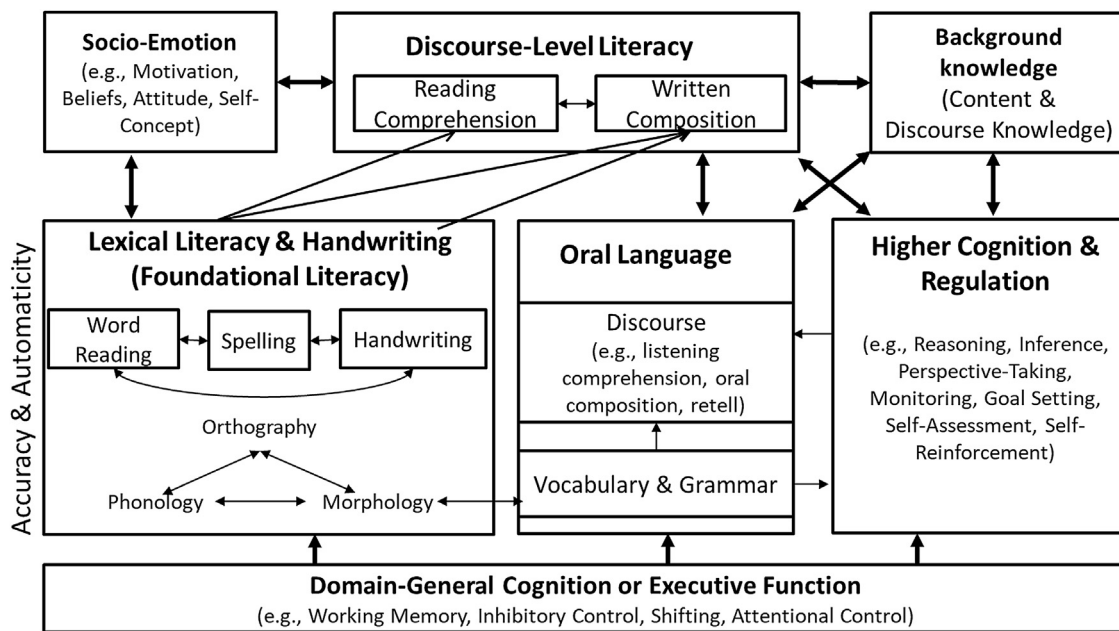

Fig. 2 Interactive dynamic literacy model. Reproduced from Kim (2020d).

The shared knowledge hypothesis was recently expanded in the interactive dynamic literacy model (Kim, 2020d). **Fig. 2** shows details on the shared language and cognitive skills and knowledge as well as the nature of their relations according to the interactive dynamic literacy model (Kim, 2020d). Reading comprehension and written composition are both discourse-level literacy skills, built on lexical literacy skills (word reading and spelling) and handwriting/keyboarding, oral language skills (vocabulary, grammatical knowledge, and discourse language skills), higher order cognition and regulation, and background knowledge. All these are built on domain-general cognition or executive function. Reading and writing skills also interact with socio-emotions toward reading and writing.

The interactive dynamic literacy model has four hypotheses regarding the nature of relations. The first hypothesis is that the skills and knowledge that contribute to reading and writing skills (component skills) have hierarchical relations. According to this hypothesis, the component skills do not have a flat structure where every skill and knowledge is directly related to reading comprehension and written composition. Instead, there are multiple layers of higher order and lower order skills, and lower order skills support higher order skills in a systematic and cascaded way, resulting in multiple chains of relations. For example, domain-general cognition supports phonological, orthographic, and morphological awareness, which, in turn, support lexical literacy skills (word reading and spelling) and handwriting/keyboarding skills, which support reading comprehension and written composition. Domain-general cognition also supports vocabulary and grammatical knowledge (morphosyntactic and syntactic knowledge),

which, in turn, support higher order cognition and regulation, which support discourse oral language skills (e.g., listening comprehension, oral composition, retell), which, in turn, support reading comprehension and written composition (see Fig. 2). The hierarchical relations hypothesis entails a series of interconnected relations among skills such that the numerous language and cognitive skills and knowledge are directly "and" indirectly related to reading comprehension and written composition. Therefore, once higher order skills are accounted for, the direct relations of lower order skills to reading comprehension and written composition are reduced (in the case of partial mediation by higher order skills) or disappear (in the case of full mediation by higher order skills). For example, if a statistical model includes working memory, vocabulary, and listening comprehension as predictors of reading comprehension, working memory and vocabulary would not directly predict reading comprehension because their contributions are captured by listening comprehension, a higher order skill, as long as listening comprehension is adequately measured (i.e., the vocabulary and working memory demands of listening comprehension tasks and reading comprehension tasks do not vastly differ; see Kim, 2020b, 2022b for further details).

The second hypothesis of the interactive dynamic literacy model is that reading and writing skills as well as their component skills develop interactively, influencing each other (i.e., interactive relations hypothesis; Kim, 2020d). The interactive relations are mediated by learning experience and practice. Reading and writing have bidirectional relations (Ahmed et al., 2014; Shanahan and Lomax, 1986), and reading experience supports writing skills, and writing experience supports reading skills (Graham et al., 2018). For example, reading texts helps individuals recognize and learn text structures, linguistic features, and authors' purpose and intent, all of which support writing texts; the experience of writing texts also helps individuals understand these aspects, which, in turn, supports reading comprehension (Graham and Hebert, 2010). Word reading experience leaves orthographic, phonological, and morphological traces in memory, which supports spelling development, and the same applies to the experience of spelling words for word reading development. Similarly, vocabulary knowledge supports reading comprehension, and students with better reading comprehension tends to read a greater amount of texts than students who struggle with reading, which leads to greater exposure of vocabulary, which leads to better reading comprehension. Successes or failures of reading and writing experiences trigger one's socio-emotions toward reading and writing, which, in turn, support or inhibit the development of reading and writing skills, which further leads to socio-emotions toward reading and writing.

Interactive relations implicate virtuous and vicious cycles of development of reading and writing skills, and their component skills. This hypothesis is akin to the Matthew Effects hypothesis in learning—the rich get richer, and the poor get poorer (Stanovich, 1986). Initial skill level is critical to setting off the cycle, and therefore, supporting development of foundational skills is crucial for successful reading and writing development. Also critical is continuous support for reading and writing development and their component skills with sustained instruction and opportunities for practice as learning experiences and practice are key to promoting the virtuous cycle and breaking the vicious cycle.

The third hypothesis of the interactive dynamic literacy model is that reading and writing difficulties co-occur (Kim, 2020d). If reading and writing are related and they rely on largely the same resources, success or difficulties with reading and writing development likely co-occur. Those who experience difficulties in reading will likely experience difficulties in writing, and vice versa (e.g., Graham et al., 2021). Furthermore, aligned with the hierarchical relations hypothesis, difficulties with reading and writing co-occur with weaknesses in oral language and cognitive skills. That is, those who have a weak foundation in oral language skills (including those with developmental language disorder) likely experience weak reading and writing skills (Berninger et al., 2015; Carretti et al., 2016; Catts et al., 1999; Dockrell and Connelly, 2015; Fey et al., 2004; Graham et al., 2020). Those who have weak skills in lexical literacy skills (word reading and spelling), including those with dyslexia, also experience difficulties in reading comprehension and written composition (Berninger and May, 2011; Berninger et al., 2008; Botting, 2007; Catts et al., 2005). Those who have weak higher order cognitions (e.g., inference or perspective taking) also experience difficulties in comprehension (Cain and Oakhill, 2007) and composition (Kim, 2020c; Kim and Park, 2019). Those who have weaknesses in working memory or attentional control are vulnerable to weaknesses in language and cognitive skills, and consequently in reading comprehension and written composition (Berninger, 2008; Kim, 2020b,c).

The last hypothesis is dynamic relations: reading-writing relations differ due to the development of reading and writing skills, grain size of reading and writing, and tasks and measurement (Kim, 2020d). Dynamic relations as a function of development refer to differential roles of component skills to reading and writing skills depending on the developmental phase of lexical literacy skills (word reading, transcription). In the beginning phase, lexical literacy skills have a large influence on discourse literacy skills. Development of lexical literacy skills reduces its constraining role, and permits oral language, background knowledge, and higher order cognitions to play greater roles in reading comprehension and written composition (Kim, 2020b; Kim and Graham, 2022).

The strength of reading-writing relations also differs as a function of grain size: The relation is stronger between word reading and spelling than between reading comprehension and written composition. Indeed, evidence indicates that word reading and spelling are very strongly related whereas reading comprehension and written composition are moderately related (Kim et al., 2022). The differential strength of reading-writing relations has implications for the occurrence of reading-writing difficulties. The strong relation between word reading and spelling implies that individuals who struggle with word reading are highly likely to experience difficulties with spelling, and those who struggle with spelling are highly likely to experience difficulties with word reading. The moderate relation between reading comprehension and written composition implies that although strong readers tend to be strong writers, there will be more divergent cases—skilled readers may not necessarily be strong writers (Kim, 2020d).

Word reading and spelling are strongly related because they essentially involve the same processes of retrieval of graphemes and their associated phonological (and morphological) information. Although the sequence of processes involved in word reading and spelling is opposite—word reading involves retrieving letters and graphemes and their associated phonological (and morphological) information, selecting appropriate grapheme-sound correspondences, and assembling them, whereas spelling involves retrieving accurate phonological (and morphological) information, mapping them with graphemes, and assembling and writing graphemes in correct order (Ehri, 1997; Kim, 2022a)—word reading and spelling rely on the same constrained set of skills: phonological, orthographic, and morphological awareness.

Compared to word reading and spelling, reading comprehension and written composition involve considerably divergent processes although they both involve meaning-making processes and draw on highly similar skills and knowledge. In reading comprehension, the text is given to readers and therefore, the extent of meaning-making is delimited by the given text (Kim, 2020d; Langer, 1986; Langer and Flihan, 2000). In written composition, the writer has to create a text, and therefore, the idea generation delimits the subsequent writing process. Let's take an example of reading versus writing a recipe. When reading a recipe, one needs to decode, understand each proposition, and develop a mental model of the cooking sequence. When writing a recipe, one has to know and select a recipe to write about, think about necessary materials (ingredients, tools) and the organization of each step, think about how to express each step by selecting vocabulary and sentence structures, and consider readers' needs (what units of measurement to use, whether to use images such as pictures for which steps, how much detail to provide, and what style of language and organization to use). This illustration clearly shows that writing a recipe requires more than knowing or comprehending a recipe. It requires extensive planning and critical thinking to a much greater extent than reading a recipe. In other words, although both reading comprehension and written composition draw on highly similar skills and knowledge, the skills and knowledge are differentially tapped during reading and writing processes.

The relation between reading and writing, particularly between reading comprehension and written composition, is also expected to differ depending on the dimension of writing—reading comprehension is more strongly related to writing quality than writing productivity (Kim and Graham, 2022; Kim et al., 2022). Written composition is evaluated in multiple ways. For instance, quality of overall writing, the presumed outcome in written composition, typically evaluates quality of ideas, organization, word choice, sentence structures, voice, spelling, and punctuation. Measures beyond writing quality are also widely used in the field, particularly for developing writers, including writing productivity (amount of written text; Anderson, 1988; Kim et al., 2015), writing fluency ("efficiency and automaticity in writing connected texts"; Kim et al., 2018, p. 322), or curriculum-based writing indicators (CBM writing; e.g., correct minus incorrect word sequence; Graham et al., 2011; Kim et al., 2015; McMaster and Espin, 2007). While these indicators are not the ultimate goal of written composition, they are used as indicators of writing quality for developing writers as they are reliable, have high utility for progress monitoring purposes, and are moderately to strongly related to writing quality for developing writers (Kim et al., 2015; Kim and Graham, 2022). However, the extent to which writing quality, writing productivity, writing fluency, and CBM writing draw on language and cognitive skills differs. Writing quality draws on all the skills shown in Fig. 2 whereas writing productivity and writing fluency are strongly influenced by transcription skills, and CBM writing is strongly influenced by one's grammatical and spelling skills (Kim et al., 2014, 2015; Kim and Graham, 2022). Given the multidimensional nature of written composition, the magnitude of the relation between written composition and reading comprehension varies depending on the focal dimension of written composition (Kim and Graham, 2022; also see Kim, 2022b; Francis et al., 2006 for a discussion of measurement of reading comprehension).

Reading-writing relations are also expected to vary depending on tasks. Reading and writing are used in a variety of tasks for different goals, and different tasks differentially tap skills. For example, reading a recipe to prepare dinner versus reading about World War II for a class project would not require the same extent of language and cognitive skills. Similarly, higher order cognitions are differentially needed for writing a short recount of a weekend activity versus writing a book report elaborating on motivations and behaviors of multiple characters. Depending on the nature of the tasks and goals, readers and writers draw on skills and knowledge differentially (Kim, 2020a,b; Kim and Graham, 2022).

Implications

Reading and writing skills as well as their component skills develop interacting with environments. One prominent environment that has a direct impact on reading and writing development is formal instruction. Variation in quality of instruction makes a difference in students' reading and writing development (e.g., Connor et al., 2013; Gersten et al., 2010; Kelcey and Carlisle, 2013). Theoretical models and evidence reviewed above imply that component skills of reading and writing development need to be systematically and explicitly taught. For example, for word reading and spelling development, orthographic symbols and their associated sounds, phonological compositions of words, and morphological structures need to be taught. Unlike oral language skills, reading and writing skills do not develop "naturally" (Rayner et al., 2001), and cracking the code requires explicit and systematic instruction for the majority of learners (e.g., Foorman et al., 2016; Graham and Santangelo, 2014; NICHD, 2000; Snow et al., 1998). Instruction should also target oral language skills and higher order cognitions, and support building background knowledge as early as possible. "Natural" development does not discount the importance of environmental input—although individuals develop oral language skills as long as language experience is present, linguistic environment has considerable influence on language development (e.g., Hart and Risley, 1995). Vocabulary tends to receive instructional attention when it comes to oral language skill, but oral language skill is a much larger construct, which includes syntax or sentence structures and discourse skills (e.g., listening

comprehension, oral retell and composition; Kim, 2016, 2020a). Higher order cognitions such as inference are often taught in the context of reading comprehension when students have developed word reading skills. However, higher order cognitive skills develop and should be also fostered in the oral language context before reading skills develop.

The hierarchical nature of relations indicates that instruction should be systematic considering the chain of interconnections (Kim, 2020b, 2022b). For instance, fluent word reading and spelling skills are needed to free cognitive resources for higher order thinking processes. Interactive relations indicate that integrated instruction of reading and writing, in addition to instruction that focuses on reading and writing respectively, will result in a synergistic effect that maximizes reading and writing development (Graham, 2021; Kim, 2020d). The hypothesis of co-occurrence of reading-writing difficulties implies a need for attending to reading and writing skills together in identifying and addressing students' needs. For example, for individuals with dyslexia, it is important to consider and address difficulties not only in reading, but also in writing. Similarly, for individuals with writing difficulties (including those with dysgraphia), difficulties in reading should be assessed and addressed (Kim, 2020d).

Lastly, the complex and multi-dimensional nature of reading comprehension and written composition suggests a need for a thoughtful approach to measuring reading comprehension and written composition, and a need for taking this into consideration in assessment and instruction. For example, it is important to use multiple tasks to measure reading comprehension and written composition skills precisely, especially for high-stakes decisions (e.g., determining one's eligibility to school-based services; e.g., Francis et al., 2006; Kim et al., 2017).

Acknowledgments

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