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ORIGINAL RESEARCH

Introduction to the Special Issue: Misalignment, Misinterpretation, and Misappropriation of Literacy Research to Practice and Policy

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Abstract
This special issue presents recent research designed to translate research into practice and policy so literacy interventions can make sustainable changes in schools worldwide. Integrating learning theories with a bioecological model of human development, we examine how research is translated for practice in policy, textbooks, and interventions. This compilation includes reports of PreK–Grade 8 interventions for reading, writing, science, and impact of evidence-based interventions for teacher practice-based professional development in reading comprehension. We further examine how professional development facilitates the adoption of reading and writing interventions. Finally, textbooks serve as the conduit for translating research and policy for classroom use and a previous special issue (2021) in this Journal reported on reading textbooks across the world. In this special issue, we update the review of textbooks to include writing and science. Our goal is to promote sustainable change by highlighting implementation challenges in school contexts worldwide.

Keywords Reading comprehension · Writing · School implementation · Technology · Textbooks · Text structure · Self-regulated strategies development · Early childhood · Elementary school · Middle grades

Rigorous research is essential to inform the continuous improvement of teaching and learning. Literacy is vital throughout one's lifespan for learning, problem-solving, and communication (Lyon, 2001). Reading and writing are foundational in language, science, social studies, arts, music, and mathematics learning in PreK-Grade 12 schools. This special issue uncovers systemic and structural factors that potentially contribute to the success or failures of the research, practices, and policies about learning. Manuscripts highlight research about

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interventions for students for reading and writing at early childhood or elementary grade levels. Other publications identify how research is translated into textbooks and resources in writing and science at elementary and middle grades. Finally, research about improving teacher knowledge to improve student outcomes is presented. This Special Issue begins with a synthesis of learning theory in the context of schools, followed by practical highlights about literacy research, policy implications, and challenges to translating research to practice.

1 Cognitive Theory of Learning and Literacy in School Contexts

Theories of human development, learning, and cognition identify components and constructs that contribute to knowledge acquisition. Knowledge acquisition is the process by which children and adults engage with their environment (e.g., reading, classroom activities, outdoor observations) and ultimately change their long-term memory to be well-integrated and associated for retrieval and use in academic, professional, and everyday activities (Bransford & Donovan, 2005; Cromley & Azevedo, 2007; Kintsch, 2005). Thus, a learner may read a text to gather information about, for example, how wolves adapt to an environment. As learners read the passage, they would need to select important information (e.g., factors that promoted or discouraged adaptations), associate the ideas, and ultimately store the information in their long-term memory. It is inefficient and ineffective to memorize scientific text and store all information in memory. Instead, important information is stored and logically connected to related background knowledge about animals and adaptation (van den Broek et al., 1999). These logical connections should develop strong associations that promote retrieval of the information when necessary. The same student studying biology or animal conservation may read about other animals such as caribou or a speckled moth that became extinct because they were unable to adapt to the environment. They should be able to retrieve the associated long-term memory about wolf adaptations and compare the similarities and differences between the different animals and their adaptations. The new schema combining information from the three types of animals is integrated into the long-term memory along with the previous factors about wolves. If they become a biologist or conservationist, all the knowledge stored in long-term memory should be readily retrievable and assist in thinking and problem solving.

Another example displays how learning about Newton's Laws of Motion in science should result in an understanding of how an automobile accelerates, what happens in a crash, and the resultant damage to the car and surroundings. This information should be integrated into long-term memory and accessible to an automobile engineer who has to design a safe car or an insurance agent or police officer investigating a crash (e.g., how fast the driver was moving to cause this type of accident and damage). Similarly, proficient and productive learners, professionals, and lifelong learners integrate literacy content, strategies, and self-regulation skills to read, synthesize, and write to improve and communicate their knowledge and ideas.

Receptive (i.e., listening, reading) and expressive (i.e., speaking, writing) communication skills are literacy skills that enable and promote comprehension throughout life. The term learning and reading/listening comprehension are closely related and used in different domains to describe generating, associating, sustaining, and retrieving long-term memory

(Bransford & Donovan, 2005; Kintsch, 2005). Our goal is to focus on the instruction and support that are likely to promote the generation of strongly associated and integrated long-term memory regardless of whether it is referred to as learning or comprehension. This special issue focuses on learning in formal instructional systems schools, replete with complex contextual factors. Consequently, we rely on complexity theory and Bronfenbrenner's bioecological theory of human development to shed light on the broader learning context that influence student learning and comprehension. The bioecological theory posits that personal characteristics, processes, and contextual factors interact over time, resulting in human development as an ongoing process (Bronfenbrenner, 1986). Beyond theory, empirical evidence confirms that contextual factors, such as community socioeconomics, teacher knowledge, and school curricula, affect learning outcomes (Lyon, 2001; Reardon, 2011). For brevity, we present examples of these complex factors from the literacy domain, beginning with the current research and evidence-based practices followed by misalignment and misappropriation of policy and research.

2 Literacy Research Highlights – There are Evidence-Based Interventions

Researchers continue to generate and refine interventions and report estimates of the impact on learning and development. Most of these studies focus on the students, their background and individual differences, and outcomes at the student level or aggregate means and standard deviations for groups (e.g., classroom, school). A landmark commissioned study titled the National Reading Panel (NRP) Report, published in 2000 presented guidelines for improving reading across the lifespan. The Report synthesized meta-analyses and recommended instructional practices for improving phonemic awareness, decoding, fluency, vocabulary knowledge, and comprehension (e.g., Ehri et al., 2001; Stuebing et al., 2008). Despite the billions of dollars invested in refining these interventions, the results have not been generalized to large populations (Pogrow, 2023). Most studies report working for some children under some conditions, on some measures, sometimes (Shanahan, 2020).

In response to the stubbornly resistant test scores, more money was dedicated to translating research findings, curating the evidence, and reporting on possible solutions for practitioners. The United States Department of Education established the What Works Clearinghouse (WWC) to review education research and publish its findings as intervention reports, offering easy-to-understand guidance about the quality of the studies and outcomes. The intention was to identify "what works" to help teachers make informed instructional decisions.

In 2020, the WWC reviewed the large-scale randomized controlled studies conducted on the text structure-based comprehension interventions delivered through the intelligent tutoring system (ITSS) and reported that the results met their highest evidence standard and produced positive outcomes for students in grades 4 and 7 (WWC, 2020). Meta-analyses and WWC practice guides further highlight the accumulating evidence for comprehension using text structures (Boegards-Hazenberg et al., 2021; Hebert et al., 2016; Vaughn et al., 2022).

The evidence on text structure strategies and their computerized web-based versions (i.e., ITSS) suggests that students process text information better when they organize their thinking based on the structures of texts (Wijekumar et al., 2012, 2014, 2017). Using the

process helps students think beyond literal information in the text (e.g., when, where, definitions), leading to inferential thinking to tie a solution to a problem, compare information across categories, etc. These knowledge-building practices, believed to be "higher-order" thinking processes (Zhang et al., 2021), help students efficiently identify the main idea in a text. Generating a main idea requires the reader to select important ideas, logically connect them, integrate them into long-term memory, and associate them. The text structure strategy scaffolds these steps with guidance from sentence stems (e.g., cause and effect = the cause is _____ and the effect is _____) that promote the selection, encoding, and decoding of logically integrated long-term memory.

Like reading, writing scores remain stagnant, and research has focused on addressing this challenge (NAEP 2017). Strategies development interventions appear most promising to solve this problem (Graham et al., 2012a, b). Writing strategies that receive WWC recognitions, such as self-regulated strategies development (Graham et al., 2012a, b; Harris et al., 2008), advocate for using instruction focused on explicit instruction of cognitive strategies and component skills (e.g., understanding the prompt, planning by note-taking, addressing the audience, generating convincing ideas, composing effectively, revising), and devoting time for students to master the skills. Multiple meta-analyses also show impactful evidence-based interventions for writing and its impact on other areas such as reading and social studies (Graham et al., 2012b, 2015; Graham et al., 2020; Hebert et al., 2013).

These evidence-based literacy interventions (i.e., text structure with ITSS, SRSD for writing) show promise for improving reading and writing. Unfortunately, the diffusion and adoption of these evidence-based practices have not kept pace with the research. In the prior efficacy trials on the ITSS with high-poverty schools, we studied the intervention context to identify barriers to implementation. Using focus group meetings with teachers and school leaders (Wijekumar et al., 2019), we attempted to understand other factors that may have influenced the outcomes. This review uncovered a trove of intertwined systems-level factors that likely impacted the results. The problems included misinterpretation, misalignment, and misappropriation of policy and practice. Schools that addressed these factors showed transformational change in student outcomes (Wijekumar et al., in press). This special issue highlights these system-level factors that researchers should address as we strive to improve learning for all.

3 Systems Misinterpretation of Policy

All national and state standards on reading and writing are derived from sound theoretical and empirical evidence. Thus, the NRP and other compilations of literacy constructs carefully report on skills, enabling/prerequisite skills (e.g., fluency as a necessary prerequisite to reading comprehension), and possible alignment of these skills vertically (e.g., greater emphasis on phonemic awareness in grades K-2 with changing emphasis to comprehension in grades three and above). These standards are critical in evaluating learning outcomes for monitoring student progress at the classroom and school levels. The standards drive measurement and interpretation of high-stakes assessments. Thus, state funding may be tied to school funding and influence real estate values, with higher-performing schools correlated with higher-value homes.

Consequently, the standards and assessments go hand-in-hand with the textbooks, being the intermediary that translates the standards into practical and usable resources. The standards (e.g., Common Core State Standards - CCSS, Texas Essential Knowledge and Skills - TEKS) applied in textbooks are frequently misinterpreted, with skills taught in isolation and rarely acknowledging each subskill's dosage.

Researchers have examined how instructional activities in textbooks in different countries align with instructional standards and reading comprehension theories (e.g., Wijekumar et al., 2021; Zhang et al., 2021; Peti-Stantić et al., 2021; Beerwinkle et al., 2018; Beerwinkle & McKeown et al., 2021). These studies showcase the misinterpretation challenges. For example, Beerwinkle et al. found that main ideas and summaries were infrequently taught in the U.S. in 4th and 5th-grade English language arts textbooks, and reviewed textbooks devoted more time to a less critical skill about the author's purpose. Similarly, textbooks in other countries (e.g., Austria, Mainland China, Portugal) seemed to have an unbalanced representation of text structures and less focus on main idea generation, summarization, and inferencing (see Wijekumar et al., 2021, on textbook analyses across countries).

Further compounding this problem was the lack of emphasis on time and effort to master essential core reading comprehension skills such as main ideas and summaries. Equal or more time was devoted to non-essential skills such as the author's purpose. Critical core skills were never integrated into each reading because of the spiraling of skills in isolation. Wijekumar et al. (2020) reported high-stakes assessment data showing students in upper elementary grades did not master main ideas and summaries but coasted to passing the test on other non-essential construct knowledge about the author's purpose and character traits. As students advance to higher-grade levels, missing the very important skills of main ideas, summarization, and inferencing will pose increasing challenges when the learner faces more complex and advanced texts in content areas such as science and social studies. Thus, not devoting the strategies, time, and resources to mastering these important skills will continue to stymie comprehension. Beerwinkle's (2018) textbook review shows that the dosage for the essential core skills (i.e., main idea, summary, and inference) was insufficient and not integrated into all reading materials (e.g., stories, expository texts, poetry, biographies) and subject areas (e.g., science, social studies). It is unlikely that children will master the essential core skills such as generating a main idea statement by practicing it just twice a year. Ultimately, this leads to a lack of strong memory connections promoted by generating the main ideas, summaries, and inferences, to associate with long-term memory.

Another review of textbooks used in European countries showed an even more troubling picture of science content being converted to narrative/story-like text to encourage students' motivation to read (Boegards-Hazenberg et al., 2022). Unfortunately, motivational techniques like these have not improved scientific knowledge and may even contribute to a lack of deep understanding of scientific concepts. In fact, science texts written in comparison text structure may promote associated memory structures using the comparisons. For example, a text comparing mollusks and fish on their body parts, habitats, respiration, and diet can help students quickly organize and learn about their similarities and differences. This promotes long-term well-associated memory about mollusks and fish. However, if written in narratives (e.g., a mollusk runs into a fish and asking questions about themselves), upper elementary students may spend time understanding the story structures rather than learning essential science knowledge. Thus, the students will be devoting valuable science instructional time in reading stories and risk developing science misconceptions because of the

narrative science texts. Again, misinterpretation of the science standards in textbooks and resources poses a threat to learning and comprehension.

In response to these challenges, Beerwinkle and Nelson (this special issue) report on a how science textbooks use text and visuals, and instruction to promote science learning. This makes an important contribution to the field of science learning. This review informs our understanding of how textbooks translate science policy for consumption in middle schools.

Writing is another critical aspect of literacy ignored or downplayed in textbooks. The misassumption is that if students can read, they can write and therefore little time is devoted to teaching writing. The Writing Computer-Based Assessment Study administered by the National Assessment of Educational Progress (NAEP, 2012) found that 39% of Grade 4 students have little to marginal writing skills, making it difficult to produce high-quality essays. As the NAEP results continue to show, without explicit instruction on writing strategies, students are not able to use the knowledge they gained from reading to enrich their ideation for writing. A lack of writing skills prevent students from expressing themselves in the classroom and beyond. Thus, the writing textbook review by Camping et al., (this special issue) makes an important contribution to identifying what is taught about writing at elementary grades.

Additionally, when textbooks teach writing, the focus is on non-evidence based approaches and iterating on organizational routines such as plan, compose, and revise, assuming the students know how to plan, compose, and revise. Each segment of the writing routine is a very complex set of activities requiring teacher cognitive modeling, scaffolding, and frequent practice and feedback delivered by trained teachers (Wijekumar et al., 2021b). Based on CCSS, students in Grades 4 and up should have written texts with clear organization, appropriation to the audience, rich ideation and details, and the ability to revise and edit (National Governors Association, 2010). It is imperative that the meta-analyses findings and WWC practice guides on writing be translated by textbooks to implement evidence-based writing instruction in schools (Graham et al., 2012b, 2015; Graham et al., 2020).

The writing textbook review in the special issue by Camping et al., is the first of its kind. It significantly contributes to setting the record straight in comparing what should be done with how textbooks have misinterpreted the standards. In specific, they found that textbook did not offer strategies including planning, organization, ideation, and setting purposes. Without explicit instruction in textbooks, teachers will incur the burden to identify and implement evidence-based writing strategies, and if teachers did not have time or resources to integrate these strategies either, students may experience significant learning loss. The NAEP results point to the latter, with students experiencing poor writing outcomes.

4 Rocky Road to Translating Research to Practice – Misappropriation of Research

The text structure-based comprehension framework discussed in this introduction and Peti-Stantić et al., 2021; WWC, 2020) showcase how students can learn to generate main ideas, summaries, and inferences by selecting important ideas, logically connecting the ideas into long-term memory using higher order text structure sentence stems (e.g., the causes are: ___, ____, the problem is ____ and solutions are ____, ____). These sentence stems were

recommended based on research in 2001 (Meyer & Poon, 2001) but remained elusive to any learners. Schools rely on textbooks and curricular resources to translate research into practice. Unfortunately, none of the 30 textbook series reviewed from all countries (Wijekumar et al., 2021) referenced these sentence stems. Further compounding the misappropriation problem, the textbooks guided teachers to complete worksheets for cause and effect in passages and T-Charts for comparison passages. Unfortunately, none of these resulted in students or teachers making the connection from these graphic organizers to the main ideas that were the ultimate goal recommended by the designers of this intervention.

As students continue to struggle with comprehension and the skills related to main ideas, summaries, and inferences, a cottage industry of strategies for comprehension has grown and flourished with little to no quantitative empirical evidence. Beerwinkle et al. (2018) reported on over 20 strategies practiced regularly in the classrooms studied. They suggested that too many competing strategies to generate main ideas may pose additional problems for students.

First, teachers use comprehension strategies that are not theoretically grounded and lack a common-sense test. For example, hashtag the main idea is a non-evidence based strategy used in about 22% of classrooms studied. Creating a hashtag for the text about animal adaptations will require one word and may sound interesting but lacks the depth of content and practical important information about why and how the wolves adapted to their environment. Thus, using a hashtag technique will result in poor long-term memory of the text and cause unfortunate consequences for comprehension about the subject of animal adaptations.

Second, the volume of strategies will likely overwhelm any student and create working memory issues for vulnerable special education students (e.g., a child with reading difficulties may have working memory issues, and asking them to choose from 20 options to generate a main idea is unlikely to help them). The multiple main idea options being taught to students is also likely to divert attentional resources from reading and processing the text to deciding which strategy to use. When a child with comprehension difficulties is reading the wolf adaptation article, they should devote their attentional resources to processing the text and selecting important ideas, logically connecting them (e.g., cause and effect), and integrating them into long-term memory. If they have to take a detour to figure out which of the 20 strategies they should apply, they are likely to get distracted from the main comprehension task about wolf adaptations.

In all these challenges presented here, misappropriation of research may cause unintended side effects resulting in poor comprehension outcomes for many learners. Utilizing an evidence-based practice like the text structure strategy, correctly, presents theoretically grounded and empirically verified solutions to the main idea, summary, and inferencing challenges.

5 Solutions that Address the Root Causes of Literacy Problems

Six articles in this Special Issue highlight how the text structure-based comprehension intervention has evolved and the professional development and support necessary for success. Turner (in this issue) describes the development and refinement of the knowledge acquisition and transformation (KAT) framework. The Framework is the result of empirical evaluations of the text structure strategy updated based on the complex school context of

teacher needs and textbook challenges. Turner and Duodoye (in this issue) report on the preparation and implementation of high quality research studies on the KAT framework. In this manuscript they describe details about the What Works Clearinghouse standards and how research can be designed and implemented to meet these rigorous standards. Turner (in this issue) presents a detailed description of the evolution of the KAT framework from its inception to the rich array of resources designed to address the complex systems needs in school contexts.

The delivery of evidence-based practices requires trained and proficient teachers. The journey to proficiency of instruction requires the investment of time and intentional effort by the teachers, coaches, and school leaders in a professional learning community. A series of articles focus on this journey. Zhang and Wijekumar (in this issue) report on profiles of students and correlations to instructional effectiveness in text structure. They also found a relatively low fidelity of implementing KAT framework by teachers in Grade 2 classrooms due to not allowing students to practice the text structure strategies. Moore and Lambright (in this issue) describe the rich literacy experiences that teachers support. They focus on how novice and expert teachers differ in implementing the KAT Framework in their classrooms. The authors found that it was the pedagogical language and actions used in the classroom rather than the years of experience that mattered for student learning. For example, in their study, an experienced teacher would pose a text structure question but answer themselves without giving students a chance to answer. These undergird implementation fidelity issues among teachers despite schools' claim that they use evidence-based strategies such as text structure instruction. Stack (in this issue) showcases the advancing comprehension and engagement (ACE) podcast to support family literacy and further improve translation of research to practice. This podcast is another implementation of the KAT framework designed to help families promote academic literacy knowledge for children. The KAT framework and ACE project showcase the use of multi-media and technology during the implementation of evidence-based strategies.

Two articles focus on writing instruction. Camping et al. (in this issue) conducted a review of multiple writing textbooks used in Grade 4 and 5 from a publisher. By virtue of content analysis, they found that the writing activities in textbooks did not offer explicit guidance on how to integrate writing strategies (e.g., planning, setting purposes, generate ideas and examples) into activities. Also, most activities were independent student tasks that offer limited to no guidance on how to write. Further, there were limited opportunities for students to practice writing for different audience and genres. As the authors suggested, although teachers may use alternative ways to teach writing, in many U.S. states and countries, textbooks are important resources for learning especially when teaching time and other resources are limited. Therefore, the lack of guidance and opportunities to practice writing in textbooks may have explained the low writing achievement scores discussed earlier in this article. In response to the need for trained writing instructors, Gerde and Bingham (in this issue) conducted a research study on the experience of early childhood teachers using an online learning program (*IWRITE*) to enhance knowledge in teaching early writing. IWRITE contained videos that use authentic rather than staged teaching demonstrations to help teachers learn how to teach early writing. They found that the participating teachers generally had positive (e.g., subtitles and voiceovers were appreciated) and rich experience (e.g., entire videos were watched, some teachers watched the videos multiple times) with

IWRITE. The authors suggested asynchronous online learning being an effective way to deliver professional development in writing.

Finally, two articles focus on the current issues in comprehension instruction. Beerwinkle and Nelson (in this issue) reviewed two science textbook series and resource compilations to identify the scope and sequence of instruction. They found that similar to reading and writing textbooks, science textbook activities also did not offer explicit instruction on comprehension and how to use visuals to facilitate comprehension. Cromley and Chen (in this issue) extend their synthesis of visuals instruction. In their literature review, Cromley and Chen replicated Renkl and Scheiter's (2017) findings by suggesting that students of all age groups, in all learning domains, and on all learning platforms struggle with comprehending visual displays. They also extended Renkl and Scheiter's finding by indicating the design flaws of visuals in learning materials; that is, the static visuals were only helpful for factual learning but not helpful for inferential comprehension of materials. They thus suggested incorporation of dynamic visuals with a combination of explicit classroom instruction on visuals.

Rice et al.'s (in this issue) systematic review found a great variation in how inferential comprehension is defined and operationalized in textbooks and assessment materials. In specific, there were 9 specific types of inference found in their review (i.e., lexical inferences, context clues, anaphoric resolution, bridging inferences, causal inferences, gap-filling inferences, lexical inferences, knowledge-based inferences, text-connecting inferences, schema-based inferences). The authors found that these inferencing types were not being represented equally in textbooks and assessments. They also suggested that researchers need to identify which instructional strategies can enhance what types of inference, rather than expecting one strategy can enhance all types of inferences.

In conclusion, research has produced sound evidence about literacy interventions that work in schools. Practitioners, policy-makers, textbook publishers, and researchers should remain vigilant and aware of the pitfalls that derail the best of interventions in the complex school settings. Highlighting successful transformations in the field will help change learning throughout the lifespan.

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