

Knowledge Acquisition and Transformation (KAT) Using Text Structures

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Proficient reading comprehension, or the ability to understand and interpret text (Castles et al., 2018), is critical for success in school and life. Students with poor reading comprehension are more likely to experience academic challenges, drop out of school, and enter the criminal justice system (Hernandez, 2011). Reading comprehension is quite complex, requiring accurate and fluent word recognition as well as the strategic application of language comprehension (Cain et al., 2020). While we acknowledge the critical role of accurate and fluent word recognition, this particular article will focus on one evidence-based method for building students' reading comprehension skills and abilities.

For many students, proficient reading comprehension can be facilitated by the explicit teaching of reading comprehension strategies, such as the identification of the main idea and summarization of what was read, which are critical for successfully understanding text (Shanahan, 2005). According to Wijekumar et al. (2020a), generating main ideas, or arriving at the gist of a text's overarching meaning, "serves as a foundation for [the] integration of ideas and connecting ideas in long-term memory" (p. 2). This means students must select and logically connect only the most important information from the text (Meyer, 1975). Understanding the logical connections between idea units in the text is considered knowledge transformation and serves as the basis of the Knowledge Acquisition and Transformation (KAT) framework presented in this article.

Researchers have found that higher-performing readers tend to utilize the hierar-

chical organization of information in texts (e.g., cause and effect text structure) to support their understanding, recall important ideas, and ask relevant questions while reading (e.g., Hiebert et al., 1983). Thus, the explicit teaching of reading comprehension strategies such as the KAT framework may be a promising avenue for students and teachers (Williams et al., 2005). Pyle et al. (2017) define *text structure* as "the organization of ideas, the relationship among the ideas, and the vocabulary used to convey meaning to the reader" (p. 469).

Meyer (1975) suggested five specific text structures: sequence, description, comparison, problem-solution, and cause-effect. These structures underlie most written text, regardless of genre, with sequence and description often nested within the other three text structures of comparison, problem-solution, and cause-effect. Within the KAT framework, we present cause-problem-solution as an additional text structure to acknowledge that all problems have a cause and the best solutions are those that address the root cause of the problem.

Accumulating evidence shows that explicit comprehension strategy instruction based on the six text structures improves the ability to select important ideas and create a logically organized memory of text while reading, resulting in improved reading comprehension for students in elementary and middle grades (Bogaerds-Hazenberget al., 2021). Moreover, several state standards (e.g., Texas Essential Knowledge and Skills) as well as the Common Core

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State Standards (CCSS; National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010) include text structure based reading comprehension instruction, and it is a frequently recommended strategy in reviewed reading textbooks for elementary grades (Wijekumar et al., 2020).

Notably, research shows that some teachers have difficulty teaching strategies designed to promote comprehension (Wijekumar et al., 2019), and many experience difficulty in identifying the main idea of a text. In fact, in their recent studies, Beerwinkle et al., (2018) found that 40% of teachers were unable to generate a main idea statement that included text organization and 60% were unable to include key ideas related to the text after reading. Moreover, Beerwinkle et al. presented evidence that ELA textbooks reviewed in the study presented comprehension strategies through weekly skill-focused units (e.g., author's purpose) in isolation and rarely devoted enough time for students to master key comprehension strategies (e.g., main idea). For instance, in Grade 5, the textbooks reviewed in the study presented instruction on main ideas and summaries only twice during the entire academic year. Similarly, in Grades 3 and 4, instruction on main ideas and summaries was presented only three times over the year. Consequently, Beerwinkle et al. found that explicit comprehension instruction on main ideas and summarization is often minimal or non-existent in many elementary classrooms.

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Not surprisingly, these factors relating to teacher knowledge and the design of instructional materials influence student comprehension outcomes (Hudson, 2021). Findings from the most recent National Assessment of Education Progress (NAEP, 2019) highlight that 66% of U.S. fourth-grade students were unable to identify implicit main ideas and key details. Moreover, many of the fourth-grade students surveyed lacked confidence in their

ability to identify the main idea of a text read independently (NAEP, 2019). Similarly, a recent review of specific reading comprehension constructs measured in a state test showed that students in Grades 4 and 5 struggled to identify main ideas and summaries of text (Wijekumar et al., 2020a). Students' inability to select important ideas, connect ideas logically, generate main ideas in writing, and extend main ideas to summaries is likely to stymie comprehension and limit their ability to progress to deeper levels of understanding (i.e., knowledge transformation; Scardamalia & Bereiter, 2006). Early research on middle-grade students' reading comprehension showed that many students engaged in knowledge telling (i.e., recalling text in a sequence) instead of knowledge transformation (i.e., understanding the logical connections between idea units; Meyer et al., 1980).

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The KAT framework that follows is one means of addressing these issues. This framework can help to build teachers' understanding of using text structure strategy instruction to promote knowledge transformation and to supplement textbook comprehension lessons in order to provide the amount of practice necessary for students to master critical comprehension strategies.

Knowledge Acquisition and Transformation (KAT) Framework

The KAT framework (formerly the Framework for the Accelerated Strategic Comprehension of Text [FASCT]; see Hudson et al., 2021 for more information) is a successful text structure-based strategy. KAT presents direct and explicit text structure instruction to improve comprehension. Two different forms of instruction are available to students. The first, a web-based intelligent tutoring system for the structure strategy (ITSS), presents instruction to the student with practice tasks and feedback. The



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second is teacher-led instruction that utilizes the local textbooks and resources to instruct students about the strategy. Both approaches scaffold students' learning of prime constructs such as main ideas, summarization, and inferring based on the most prominent structure of the text. Teachers can use the ITSS or deliver the instruction themselves. KAT guides students through the following steps:

1. Identify the overall top-level structure of a text. KAT suggests focusing on the four text structures of comparison, cause-effect, problem-solution, and cause-problem-solution because sequence and description structures are often nested within these structures (Wijekumar et al., 2012). Students may use signaling words (i.e., discourse markers, cue words, linking words) explicitly stated or implied to aid in identifying the top-level structure (Williams et al., 2009; see Table 1). Identifying the overall top-level structure can be applied to all genres of text, including expository, narrative, biography, and poetry.
2. Use a consistent sentence stem based on the overall structure of the text (e.g., The problem is _____. The solution(s) is/are ____.) to generate the main idea statement. The use of a consistent sentence stem allows students to focus on the gist of the text and guides the selection of important ideas.
3. Develop a summary by adding key details about each part of the main idea statement. Once students can identify and state the main idea, they have a starting point for effectively summarizing the text. Students are guided to the text's most important details to add to their summary by focusing on the overall text structure and main idea sentence.
4. Answer inference questions by integrating the top-level structure, main idea, and prior knowledge.
5. Use top-level structures to answer multiple-choice questions about the main idea or summary of the text.

Results

Wijekumar et al., (2012, 2014, 2017) implemented the web-based ITSS with fourth-, fifth-, and seventh-grade students in rural and suburban schools. In these studies, teachers replaced approximately 20-45 minutes of students' weekly language arts classroom instruction with the software. ITSS delivers instruction to students by using an animated pedagogical agent teacher who models text structure use and presents

practice activities, immediate assessment, and helpful feedback. Across studies, students who received the text structure instruction on ITSS performed significantly better on reading comprehension assessments than their control counterparts. It is also important to highlight that the What Works Clearinghouse (WWC, ITSS Intervention Report, 2021) has identified some of these studies (i.e., Wijekumar et al., 2012) as "Met Standards Without Reservation," indicating the highest degree of confidence that the text structure strategy intervention delivered by ITSS caused the observed gains in students' reading comprehension scores.

Most recently, Wijekumar et al., (2020b) examined the use of ITSS with fourth- and fifth-grade students at or below the 25th percentile at the beginning of the year on measures of reading comprehension, including the Gray Silent Reading Test (GSRT; Wiederholt & Blalock, 2000) as well as a researcher-developed measure. The researchers randomly assigned students' classrooms to either a treatment or control group, with the treatment group engaging in web-based KAT lessons approximately 20-30 minutes a week and the control group receiving standard reading comprehension classroom instruction. At the end of the school year, both fourth- and fifth-grade readers in the treatment group outperformed students in the control group on all reading comprehension measures.

Wijekumar et al., (2018) examined the impact of text structure based comprehension strategy instruction for Spanish-speaking English learners in Grades 4 and 5. Strategy instruction on the web for English language learners (SWELL) followed the KAT framework and incorporated supports to develop the vocabulary and background knowledge of English learners, which are key requirements for proficient reading comprehension (Kamil et al., 2008). For example, students had access to paraphrasing and linguistically appropriate definitions at the word and sentence level and the ability to listen to instructions and practice passages in Spanish before reading them in English. Over a six-to-seven-month period, students completed text structure strategy lessons with linguistic support for 45-60 minutes a week as a partial substitute for their typical language arts classroom instruction. Results showed that Grade 4 and 5 English learners improved their reading comprehension by using text structure based comprehension strategies.

Beyond the Language Arts Classroom

The use of text structure based instruction is not limited to only the language arts class-

Table 1*Main Idea and Summary Quick Guide Utilized with Students from Grades 2-12*

	Comparison	Cause and Effect	Problem and Solution
Signaling Words (*not exclusive)	instead, but, however, or, alternatively, whereas, on the other hand, while, compare, in comparison, in contrast, resemble, the same as, all but, have in common, similarities, differentiate, options, less than, act like, look like, just as, more than, longer than, despite, although, just, difference, different	cause, lead to, bring about, originate, produce, make possible, by, since, due to, because, in order to, reasons, give reasons for, the reason why, on account of, in explanation, effect, affects, so, influenced by, as a result, result from, consequence, consequent, thus, therefore	problem, trouble, difficulty, hazard, need to prevent, threat, danger, puzzle, issue, risk, to satisfy the problem, ways to reduce the problem, to solve these problems, protection from the problem, solution, response, answer, reply, comeback, recommendation, return, suggestions
Main Idea Stem	_____ and _____ were compared on _____, _____, and _____.	The main cause is _____, and the main effect is _____.	The cause of the problem is _____. The main problem is _____, and the main solution is _____.
Recall/Summary Stem	The first topic of comparison is _____. [The topic] is/has [state what was learned about the topic for that specific comparison category]. In contrast (or another signaling word), the second idea is _____. [The topic] is/has [state what was learned about the topic].	The cause was _____ [state what was learned about the cause]. The effect of this cause was _____ [state what was learned about the effect]. [Repeat for each cause/effect]	The problem was _____ [state a description of the problem and, if known, its cause(s)] _____. The solution was _____ [state a description of the solution and how it gets rid of the cause(s) of the problem(s) or tries to] _____. [Repeat for each problem and solution]

Note. Adapted from Hudson et al. (2021)

room. Beerwinkle, (n.d.) examined the effect of KAT implemented by middle-school science teachers during their daily science lessons for ten weeks. Following the KAT framework, instruction guided students in identifying the text structure in science texts, using the text structure to select important ideas, generating main ideas, connecting the ideas to develop summaries, and extrapolating inferences using text structures. Mirroring results from

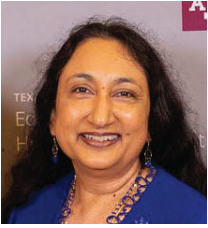
KAT research in the language arts classroom, Beerwinkle found significant improvement in students' general reading comprehension scores and science knowledge assessments. We attribute this growth to the fact that reading comprehension is required to successfully understand and answer science knowledge questions, thus suggesting that KAT can be a successful reading comprehension strategy for understanding any content area text.

Conclusion

The findings from the studies highlighted in this article demonstrate the advantage of incorporating text structure based reading comprehension instruction into classroom literacy practices. Across all text genres (e.g., narrative, expository, poetry, biography, content area), the use of KAT delivered by both classroom teachers and web-based programs (i.e., ITSS, SWELL) may help all students build critical comprehension strategies through a frequent focus on the main idea, summary, inference, and vocabulary. While this article only focuses on one research team's approach to text structure strategy instruction, we acknowledge that other applications of text structures have also produced good results (e.g., Williams et al., 2016). When teachers review textbook comprehension lessons and align current classroom practices to evidence-based comprehension strategies such as the KAT framework, they can plan and deliver effective instruction to promote positive reading comprehension outcomes and success in both school and life. ■

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