FAST FORWORD®
BY CARNEGIE LEARNING

RESEARCH BEHIND THE FAST FORWORD READING COMPREHENSION COMPONENT

Introduction

The newest component in the Fast ForWord program, Fast ForWord Reading Comprehension, combines five exercises that were originally included in the Fast ForWord Reading Level 4 or Fast ForWord Reading Level 5 components. The effectiveness of these components for building reading skills has already been documented (Scientific Learning, 2007). When these components were taken off the market for needed technology upgrades, many educators expressed interest in a component that specifically focused on reading comprehension. This need was especially keen among educators working with secondary-level struggling readers.

To meet this demand, Fast ForWord Reading Comprehension comprises five exercises, each working on specific aspects of reading comprehension:

- Art Walk – build sentences that accurately and grammatically describe complex images by using your sentence comprehension, English grammar, and visual analysis skills.
- Cognobot – answer literal and inferential comprehension questions about fiction and nonfiction passages and other texts by practicing passage comprehension skills.
- Data Stream – analyze fiction and non-fiction passages and answer questions about them by applying a variety of comprehension strategies, including graphic organizers and summaries.
- Print Shop – find the paraphrase that accurately and comprehensively represents another text by using sentence comprehension and grammar skills.
- Road Trip – select the word that correctly completes a sentence by exercising sentence comprehension, vocabulary, and English grammar skills.

All of the Fast ForWord exercises adhere to design principles based in the neuroscience of reading and learning. They provide intense, rigorous practice with adaptive progressions, immediate feedback, and motivational features to keep students engaged. While these exercises already had strong, proven content and learning design, there is always room for improvement. To understand how the exercises could be improved, the Fast ForWord research and learning design team gathered information from three sources (findings from recent scientific literature, input from students and educators, and analysis of student use data) and then applied these findings to revise the exercises.

Insights from Recent Scientific Literature

One of the guiding neuroscience principles behind the Fast ForWord program is that motivation is crucial for learning and neuroplasticity. Recent neuroscience research continues to expand our understanding of different kinds of motivation. In their 2020 study on memory formation, Duan, Fernández, Dongen, and Kohn found that intrinsic and extrinsic motivators operate through different neural pathways, with independent, additive effects. To take advantage of this, the revised exercises include gamification features that build both types of motivation.

Additions such as the new streak counters and progress indicators help to build intrinsic motivation by empowering students to take charge of their own learning experience and work toward their personal best every day. Moreover, the new extrinsic motivational system of visually distinctive levels and "level up" celebrations reinforces progress.

Points are also awarded and may also be used by teachers to provide additional extrinsic rewards, such as leader boards or token economies, based on their students' needs and interests.

Cross-training fundamental cognitive skills in the context of language and literacy activities is another Fast ForWord design principle that has been tested and expanded upon by recent research. Montgomery, Gillam, and Evans, in their 2021 review, described the strong relationship between working memory (WM) and sentence comprehension, both in students with developmental language disorder (DLD) and students with typically developing language skills (TD). Prior researchers had observed that DLD students struggle with sentence comprehension and blamed this on WM limitations, but Montgomery et al. make an important distinction. WM capacity falls on a continuum, rather than into binary categories (sufficient/insufficient). Both TD and DLD students "have sufficient WM capacity to support comprehension under certain circumstances." They also point out that the interaction between comprehension skill and WM goes both ways. Language knowledge can serve to bolster WM capacity by helping the listener/reader more efficiently chunk linguistic input.

In keeping with the researchers' recommendations for improving sentence comprehension by enhancing syntactic knowledge, the new Fast ForWord Reading Comprehension component includes two sentence comprehension exercises that have a strong focus on English grammar. Each of these exercises provides high frequency/high density exposure to examples of the target structures, within a progression that supports gradually expanding working memory capacity. For students who struggle with specific language structures, the built-in interventions will help them find "consistent patterns in the input" by highlighting specific words in the example sentences.

Recent research has also confirmed that visual attention is critical for skilled reading and a challenge for many students with dyslexia (Meri, Farah, & Horowitz-Kraus, 2020; Valdois, Reilhac, Ginestet, & Line Bosse, 2020). Several exercises in Fast ForWord Reading Comprehension help to build visual attention through the use of complex illustrations, visual/textual reference materials, and graphic organizers.

Qualitative Research with Students and Educators

Educational software can only be effective when it is well used. To better understand usability issues, our research and learning design team spoke with many educators about their implementation struggles, strategies, and successes. What these discussions made clear was that the software needs to be easy to implement, efficient with student and teacher time, and motivating for students (especially those middle and high school students who rejected the existing exercises as "too childish.")

Implementation is easier for educators when students are motivated and can get themselves unstuck. Students are more motivated when they are given grade-appropriate materials and can see their progress. Educational interventions are efficient when students have the support they need to make rapid progress. All of this can be achieved with improved design and built-in supports.

A review of the current exercise user interface and exercise mechanics revealed several ways to improve the student experience. First, to address the need for materials that look and feel age-appropriate, each exercise was given a face-lift. Timeless, secondary-appropriate STEAM themes replaced the earlier, animal character-based themes.

Next, a standardized layout was introduced. Controls and displays (e.g., points, streaks, time) now have consistent positions across exercises, so that students don't miss important resources or waste time learning where to find things. Finally, a number of new features were added to help students progress more quickly and to make their progress more visible and rewarding. As students progress, a graph at the bottom of the screen shows their percent complete for the current level.

Students can open a separate Progress screen to view their progress through the exercise as a whole. The Autoplay feature allows students to work more quickly, by serving a series of questions after one click of the Go button. If a student gets all questions in an Autoplay series correct, the next series will be one longer. The Current Streak and Highest Streak signs, in conjunction with Autoplay, provide game-like rewards for getting consecutive correct answers, encouraging students to take their time and respond thoughtfully, in order to maintain high levels of accuracy. The design of these features was informed by ongoing consultation with educators and testing with students.

Data-Driven Improvements

Finally, the research and learning design team looked at student use data from each exercise, taking a deep dive into student performance across thousands of exercise sessions. The analyses revealed where the sticking points were and what design factors might be helping or hindering student progress, and the findings led to several changes to exercise design and content.

Error analysis prompted a review of those questions that were most frequently failed. We revised any questions that appeared to be unnecessarily difficult. For example, confusingly worded questions were clarified, use of idioms was avoided (unless central to the task), and alternative answers (foils) were checked to ensure that they were unequivocally wrong.

After identifying the areas where students were more or less likely to get stuck, we developed automated interventions that target specific issues and/or teach specific concepts. For example, in Data Stream, a student who struggles with selecting logic diagrams will be provided with direct instruction on how to read and understand these diagrams.

In many exercises, the analyses revealed that the progression rules should be made more efficient. Some exercises required passing large blocks of diverse content. When students failed to meet the passing criteria, they had to repeat all of the material in that large block, even if they had already mastered much of it. This could keep students indefinitely stuck at the lower levels of an exercise. For exercises like Print Shop and Cognobot, we broke up the blocks into smaller units of related content so that students can focus their efforts on the material that is more challenging for them and more rapidly progress to higher levels.

In one exercise, it was clear that students simply ran out of time before they were able to complete most of the content. In this exercise, Art Walk, students build sentences to describe complex pictures. Each sentence is broken into between two and five segments, and the student must select the correct segments, attending to both grammar and semantics. By modifying selected sentences (reducing the number of segments that students must make decisions about), we were able to reduce the size of the exercise 28%, while preserving the rich content set and progression. This ensures that more students will have the opportunity to reach the higher-level content, which includes more challenging grammar and vocabulary.

Conclusion

The new Fast ForWord Reading Comprehension component is a collection of proven exercises that have been updated with a new look, new features, and improved content. The revised exercises are more adaptive and more supportive. They help students work independently, make rapid progress, and see their own progress. Because students work more independently and stay motivated, the revised Fast ForWord exercises are also easier to implement.

References

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