

COURSE

# The Science Behind ScootPad:

The Science driving ACT's powerful personalized mastery learning platform



Level:3  
Level:1



**ACT**<sup>®</sup>

# BACKGROUND

Teachers put a lot of time and effort into lesson planning.

In fact, almost a third of teachers' time goes into lesson planning.<sup>1</sup> During that time, they are learning and adjusting to new standards, crafting differentiated instruction, and curating and/or creating engaging content that keeps their students motivated and on track.

ScotPad is an adaptive, technology-driven platform with standards-aligned content that supports student learning with individualized instruction that can help save teachers time. It does so by providing engaging and differentiated concept-aligned instruction, thus allowing teachers to spend more time focusing on individual students. ScotPad facilitates effective student learning using personalized diagnostics, just-in-time enrichment, scaffolded supports, and automatic mastery assessment, each of which has a solid foundation backed by the science of learning. In this white paper, we provide an overview of the principles that provide this foundation.



# OVERVIEW OF SCOOTPAD

ScotPad provides curricula aligned to various standards\* in math and English Language Arts with comprehensive coverage spanning kindergarten through eighth grade. To provide comprehensive coverage, ScotPad breaks each standard down into a set of specific concepts. These concepts are linked together by a knowledge map that underlies ScotPad's adaptive learning paths. ScotPad has over 1,000 pre-defined learning paths teachers can assign students in order to meet educational goals aligned to standards. The concepts that underlie these learning paths provide comprehensive and rigorous coverage of specific standards.

Each learning path starts with a placement assessment, and ScotPad then continuously monitors student progress and adapts instruction based on individual performance. If a student is struggling with a concept, they receive instruction and additional practice with that concept. Instruction involves short, engaging videos selected based on their alignment to specific concepts. Those who struggle following this instruction receive automatic scaffolded supports involving practice and instruction on pre-requisite concepts. In contrast, when a student reaches proficiency for specific concepts, ScotPad advances them to new concepts.

As students progress through learning paths, ScotPad creates an individualized learning profile to show their learning progress. These profiles are visible via student and teacher dashboards, which provide feedback for students, and inform intervention and instructional decisions made by teachers. In sum, ScotPad continuously monitors and adapts to a student's current ability and knowledge level to help them reach mastery.

In addition to these ready-made learning paths, ScotPad offers several additional features to allow for flexibility during instruction. For instance, teachers can browse and easily assign resources to students from an extensive content bank including standards-aligned instructional videos, practice questions, and assessments. For assessments, ScotPad provides over 50 technology-enhanced question formats.

Teachers can easily use these formats to create a range of questions. For instance, they can ask students to draw graphs or fill in a classification table with multiple rows and columns. Along with other settings, teachers have further flexibility in adjusting the rewards students receive, the proficiency level required for mastery, and the rigor of practice. The unique features within ScotPad provide a great deal of flexibility so teachers can assign resources to fit their students' and classroom needs.

\* ScotPad includes curricula aligned to Common Core standards as well as 14 state-specific standards.

# SCIENCE & RESEARCH BEHIND SCOOTPAD

ScotPad leverages evidence-based learning science to provide an effective and efficient learning experience for students. Research has identified several effective learning tools to help students meet various, challenging learning goals. ScotPad incorporates many of these tools to help students meet these goals. The table below provides a brief description of each learning tool and a relevant example from ScotPad.

These examples are representative, but do not encompass all of the ways in which ScotPad implements each tool. In addition to these examples, the table gives a brief description of why each tool is important to students by delineating learning outcomes supported in the research literature. This list of outcomes is not meant to be comprehensive, but instead focuses on outcomes most supported by prior research. To that end, next to each outcome the research basis for these conclusions is denoted. Each study cited either presents a comprehensive review, nationally representative study, or a recent meta-analysis summarizing the results of many individual studies. The last column in the table provides a star rating of the research on each tool. These ratings are broadly consistent with previously established criteria used to evaluate various learning techniques.<sup>2</sup>

To earn a full three stars, the tool must be supported by a large body of research that consistently shows benefits across a variety of grades and materials. To earn two stars, the tool must be supported by a substantial body of research that shows benefits under certain conditions. For instance, this tool may be helpful for certain learners or on certain content. To earn a single star, the tool must be supported by limited research that does not demonstrate benefits consistently. Finally, the last line in the legend shows no stars. To earn no stars, the tool must be lacking any research basis. As the table below shows, ScotPad only incorporates tools with substantial research support that earned either a two or three star rating.

Criteria	Rating
Robust research support, benefits are consistent across grades and materials	★ ★ ★
Substantial research support, benefits are consistent under specific conditions	★ ★ ☆
Limited research basis, benefits are inconsistent	★ ☆ ☆
No research basis	☆ ☆ ☆

Note: ScotPad only incorporates tools that earned a two or three star rating.

# LEARNING TOOLS INCORPORATED IN SCOOTPAD

TOOL	DESCRIPTION	SCOOTPAD EXAMPLE	WHY DOES IT MATTER?	RESEARCH SUPPORT
				
<b>RETRIEVAL PRACTICE</b>	A student brings target information to mind from their long-term memory	After an instructional video, students are asked, "What are the four parts of stories you should always compare?" and the video pauses for the student to answer then provides the correct answer.	<ul style="list-style-type: none"><li>• Enhances long-term retention<sup>3</sup></li><li>• Enhances transfer of content to new contexts<sup>4</sup></li></ul>	★ ★ ★
<b>SPACING</b>	Revisiting the same concept after a delay versus immediately	ScootPad asks practice questions about evaluating claims in an informational text in an initial practice and then revisits this concept in subsequent practice.	<ul style="list-style-type: none"><li>• Enhances long-term retention<sup>5</sup></li><li>• Supports a broad range of knowledge and skills<sup>6</sup></li></ul>	★ ★ ★
<b>INTERLEAVING</b>	A schedule of practice that mixes different types of materials during a single learning session	A student switches between subtracting fractions, graphing pairs on a coordinate plane, and explaining patterns when using powers of 10.	<ul style="list-style-type: none"><li>• Supports problem solving at short and long delays<sup>7</sup></li><li>• Supports transfer of items from learned categories<sup>7</sup></li></ul>	★ ★ ☆
<b>KNOWLEDGE SEGMENTATION</b>	Instruction is presented in short segments, allowing the learner to digest one concept before moving to the next	A student practices using graphs to analyze the relationship between dependent and independent variables then writing equations to express a dependent variable in terms of an independent variable instead of practicing all concepts related to each sixth-grade math standard at once.	<ul style="list-style-type: none"><li>• Enhances transfer of content to new contexts<sup>8</sup></li><li>• Can support short-term retention and reduce cognitive load<sup>8</sup></li></ul>	★ ★ ☆



**ScootPad**<sup>TM</sup>

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TOOL	DESCRIPTION	SCOOTPAD EXAMPLE	WHY DOES IT MATTER?	RESEARCH SUPPORT
				
<b>DUAL CODING</b>	Content presented via text and relevant visuals versus text alone	An instructional video on summarizing stories presents a verbal explanation and organization chart.	<ul style="list-style-type: none"> <li>• Supports reading comprehension<sup>9</sup></li> </ul>	
<b>MASTERY LEARNING</b>	Students must reach proficiency on a concept before moving to the next concept	Before a student learns to multiply side lengths to find area, they must first learn how to count unit squares to find area and also use tiling to find area.	<ul style="list-style-type: none"> <li>• Supports academic success and achievement<sup>10</sup></li> <li>• Increases retention and supports positive attitudes<sup>10</sup></li> </ul>	
<b>COMPUTER-BASED SCAFFOLDING</b>	Identifies gaps in student knowledge and provides instruction on prerequisite concepts, at or below the grade level of the practiced concept.	ScootPad assigns how to determine the meaning of figurative language used in a literary text. Through the student's responses, it is evident the student does not have the knowledge to move on at this level. ScootPad determines that a student does not have the knowledge to determine the meaning of figurative language.	<ul style="list-style-type: none"> <li>• Supports retention<sup>11</sup></li> <li>• Supports problem solving for new and practiced problems<sup>11</sup></li> </ul>	
<b>GROWTH MINDSET</b>	The belief that abilities can grow with effort versus that they are unchangeable	A student sees the growth mindset quote on their front page, "Life isn't perfect. Any failures you have are actually learning moments. They teach us how to grow and evolve."	<ul style="list-style-type: none"> <li>• Greater likelihood of taking rigorous math courses<sup>12</sup></li> <li>• Supports a broad range of academic achievement areas<sup>13</sup></li> </ul>	
<b>DIFFERENTIATED INSTRUCTION</b>	Adapting learning activities to meet students' individual needs	Learning paths in ScootPad adjust the amount of time spent on content and amount of support given based on performance.	<ul style="list-style-type: none"> <li>• Supports academic achievement of primary<sup>14</sup> and secondary students<sup>15</sup></li> </ul>	
<b>TECH-ENHANCED PRACTICE WITH FEEDBACK</b>	Students answer questions of various formats and receive immediate automatic feedback during practice	A student is asked to graph a line and a transformation of that line. After plotting their answer, they are immediately told if their answer was correct.	<ul style="list-style-type: none"> <li>• Supports student achievement, positive behavior, and can support motivation<sup>16</sup></li> <li>• Enhances transfer of content to new contexts<sup>17</sup></li> </ul>	

# SUMMARY

As the table summarizes, ScootPad makes use of a full set of learning science tools including generalized and specialized tools that address the variety of challenges students face during learning. The first two rows show that ScootPad incorporates the two most robust learning science tools: retrieval practice and spacing. Both tools have been studied for over a hundred years and are highly recommended by learning experts and researchers.<sup>2</sup>

These are the only broadly beneficial tools learning researchers have identified given the difficulty in finding tools that are beneficial for a variety of learners and materials. In addition, researchers have identified a number of tools that are effective for specific uses. The remaining rows show that ScootPad incorporates eight of these tools with solid research support for specific uses—for instance, those learning math benefit greatly from interleaving. Additionally, knowledge segmentation is a good way to support transfer, which is an important learning outcome that has been particularly resistant to improvement.<sup>18</sup>

The full table shows that ScootPad incorporates a variety of evidence-based tools that provide comprehensive coverage of a broad range of important learning outcomes such as retention, motivation, and opting to take challenging math courses. In addition, ScootPad provides overlapping support from multiple tools for many specific outcomes. Providing multiple routes to these outcomes is crucial for students who are potentially facing many barriers to achieving their learning goals.

Taken together, ScootPad's combination of empirically supported learning tools provides comprehensive and rigorous coverage of important learning outcomes to help students achieve their learning goals and help them on their path to academic success.





## SOURCES

1. Philipp, A., & Kunter, M. (2013). How do teachers spend their time? A study on teachers' strategies of selection, optimization, and compensation over their career cycle. *Teaching and Teacher Education*, 35, 1-12.
2. Dunlosky, J., Rawson, K. A., Marsh, E. J., Nathan, M. J., & Willingham, D. T. (2013). Improving students' learning with effective learning techniques: Promising directions from cognitive and educational psychology. *Psychological Science in the Public Interest*, 14(1), 4-58.
3. Adesope, O. O., Trevisan, D. A., & Sundararajan, N. (2017). Rethinking the use of tests: A meta-analysis of practice testing. *Review of Educational Research*, 87(3), 659-701.
4. Pan, S. C., & Rickard, T. C. (2018). Transfer of test-enhanced learning: Meta-analytic review and synthesis. *Psychological bulletin*, 144(7), 710.
5. Carpenter, S. K., Cepeda, N. J., Rohrer, D., Kang, S. H., & Pashler, H. (2012). Using spacing to enhance diverse forms of learning: Review of recent research and implications for instruction. *Educational Psychology Review*, 24(3), 369-378.
6. Wiseheart, M., Kupper-Tetzl, C. E., Weston, T., Kim, A. S. N., Kapler, I. V., & Foot, V. (2019). Enhancing the quality of student learning using distributed practice. In J. Dunlosky & K. A. Rawson (Eds.), *Cambridge handbook of cognition and education*. Cambridge, MA: Cambridge University Press.
7. Brunmair, M., & Richter, T. (2019). Similarity matters: A meta-analysis of interleaved learning and its moderators. *Psychological bulletin*, 145(11), 1029.
8. Rey, G. D., Beege, M., Nebel, S., Wirzberger, M., Schmitt, T. H., & Schneider, S. (2019). A meta-analysis of the segmenting effect. *Educational Psychology Review*, 31(2), 389-419.
9. Guo, D., Zhang, S., Wright, K. L., & McTigue, E. M. (2020). Do You Get the Picture? A meta-analysis of the effect of graphics on reading comprehension. *AERA Open*, 6(1), 2332858420901696.
10. Batdi, V. (2019). A Meta-analytic comparison of mastery model and traditional methods? Effects on academic success, retention, achievement and attitude. *Mehmet Akif Ersoy Üniversitesi Eğitim Fakültesi Dergisi*, 1(40).
11. Belland, B. R., Walker, A. E., Kim, N. J., & Lefler, M. (2017). Synthesizing results from empirical research on computer-based scaffolding in STEM education: A meta-analysis. *Review of Educational Research*, 87(2), 309- 344.
12. Yeager, D. S., Hanselman, P., Walton, G. M., Murray, J. S., Crosnoe, R., Muller, C., ... & Paunesku, D. (2019). A national experiment reveals where a growth mindset improves achievement. *Nature*, 573(7774), 364-369.
13. Sisk, V. F., Burgoyne, A. P., Sun, J., Butler, J. L., & Macnamara, B. N. (2018). To what extent and under which circumstances are growth mindsets important to academic achievement? Two meta-analyses. *Psychological Science*, 29(4), 549-571.
14. Smale-Jacobse, A. E., Meijer, A., Helms-Lorenz, M., & Maulana, R. (2019). Differentiated instruction in secondary education: A systematic review of research evidence. *Frontiers in Psychology*, 10, 2366.
15. Deunk, M. I., Smale-Jacobse, A. E., de Boer, H., Doolaard, S., & Bosker, R. J. (2018). Effective differentiation practices: A systematic review and meta-analysis of studies on the cognitive effects of differentiation practices in primary education. *Educational Research Review*, 24, 31-54.
16. Wisniewski, B., Zierer, K., & Hattie, J. (2020). The power of feedback revisited: A meta-analysis of educational feedback research. *Frontiers in Psychology*, 10, 3087.
17. Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of educational research*, 77(1), 81-112.
18. Nokes-Malach, T. J., & Mestre, J. P. (2013). Toward a model of transfer as sense-making. *Educational Psychologist*, 48(3), 184-207.