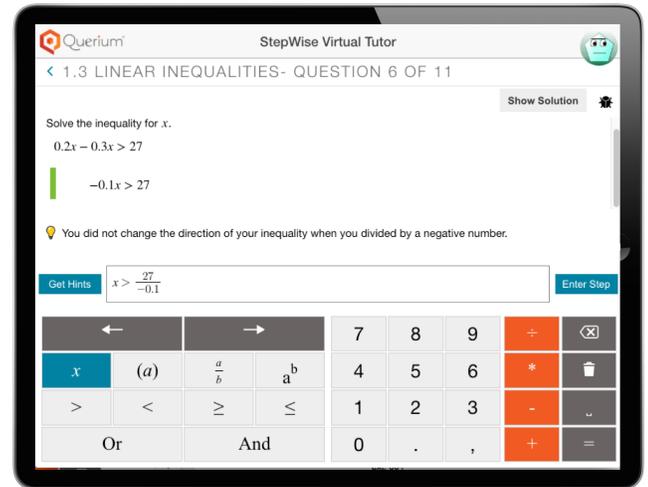


StepWise™ Virtual Tutor for Algebra

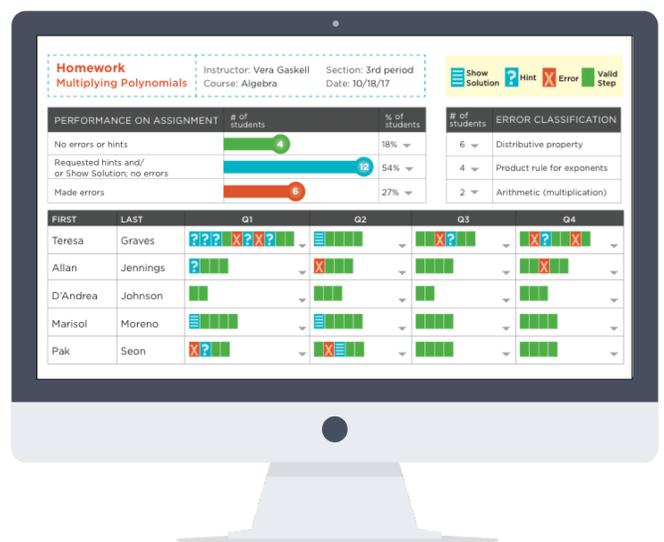
The A.I. tutoring system built with the wisdom of master teachers

The Problem We Solve: Lack of math competence is an epidemic in the US. Only 23% of high school seniors are considered proficient in Math.¹ Success in algebra is generally agreed to be an important gatekeeper to academic success in high school and beyond. As a required course in most high schools, Algebra 1 represents a shift from the tangible numerical operations to more abstract concepts. The shift is difficult for many students and nearly 44% of the students in California who take Algebra 1 are required to take it again.² Teachers know that the best way to help their students is to work with them 1-on-1 while they solve problems, but this isn't possible outside of tutoring centers. Meanwhile, most students do their homework alone, potentially solving dozens of questions the wrong way, or getting frustrated and stuck, unable to get help.



Querium's StepWise Virtual Tutor provides instant feedback at the student's moment of confusion, coaching them back on track to understanding and success. StepWise also delivers micro-assessment data to teachers about students' errors and problem-solving abilities so that they can give targeted intervention.

Product Description: StepWise uses an AI expert system to help students master mathematics from Pre-Algebra through College Algebra. Within StepWise, students solve problems by submitting each step for evaluation. The AI engine immediately tells students if their step is correct or incorrect. If students request hints, StepWise informs them why the step is wrong or suggests what to do next. Hints can be scaffolded to encourage productive struggle. Students may also ask to be shown turn-by-turn instructions to complete the solution at any point while solving a problem. By recognizing and recording errors students make, StepWise captures data to provide teachers detailed reports of the types and frequency of errors to inform instruction. Querium designed StepWise to be easily integrated into publishing partners' platforms as an alternative assessment type. Querium licenses its technology to publishers to provide a force multiplier for the online homework and assessment engine.



1. National Center for Education Statistics (2014). Are the Nation's 12th graders making progress in Mathematics and Reading? NCES 2014-087
2. Fong, A.B., Jaquet, K., & Finkelstein, N. (2014). Who repeats Algebra 1, and how does initial performance relate to improvement when the course is repeated? (REL 2015-059).

Research and Results: With support provided by the SBIR program at the U.S. Department of Education’s Institute of Education Sciences (contract ED-IES-16-C-0011), Querium developed a demonstration site for StepWise with 15 Algebra Common Core State Standards broken down into 38 Learning Objects. Querium partnered with WestEd to plan and conduct a Study of Promise using a randomized control trial design in which teachers were assigned to use StepWise either as a supplement to their algebra instruction, or to conduct their algebra instruction in the usual way. The Study was conducted over six weeks between September and November 2017.

Teachers used StepWise in varied ways – as warm-up, practice/review, or homework – indicating that it can be flexibly adapted to fit a variety of classroom needs. Teachers and students both indicated that the immediate feedback was a clear benefit of the program.

“ I would say the number one feature is that it gave (students) feedback step by step. That was wonderful compared to any of the other programs used. ”
Study of Promise Teacher

Improved Performance: Treatment students scored approximately 8% higher overall on a standardized geometry readiness test after just 6 weeks of using StepWise. Students scored 16% higher from pre-test to post-test on the topics that were the focus of the intervention: linear equations and functions. Compared with the control students, treatment students’ gain was 11% higher on functions and 6% higher on linear equations.

Greatest Improvement: WestEd researchers also explored whether the impact of StepWise varied for subgroups of students. The researchers grouped students by their Smarter Balanced test scores from the previous spring test administration, then looked at growth demonstrated as a result of using StepWise. They found that StepWise had a sizable positive effect on the students who previously scored lower on the Smarter Balanced math assessment. The significance here is that StepWise Virtual Tutor has tremendous potential to help struggling students become successful learning algebra and, as a result, develop greater confidence in their math skills.

Study of Promise Participants

- 20 Algebra Teachers
 - 9 treatment
 - 11 control
- 531 Students
 - 266 treatment
 - 265 control
- Free & Reduced Meals: 49%
- Avg Teachers’ Years of Experience: 5.2

Treatment students scored 16% higher on topics that were the focus of the study after just 6 weeks of using StepWise.

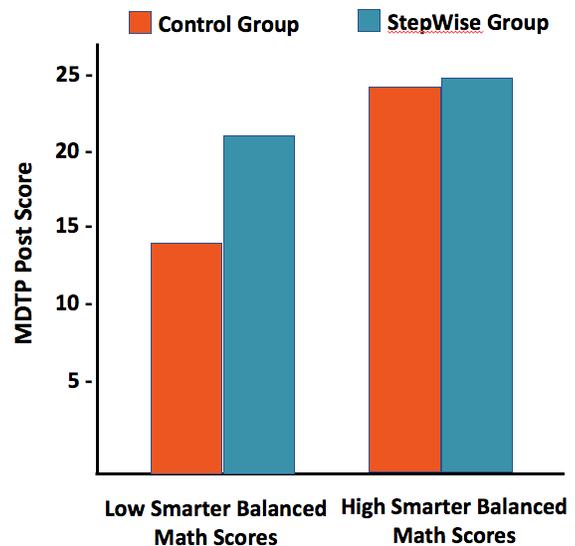


Figure 1. MDTP Post-test scores, grouped by students who previously performed lower or higher on the Smarter Balanced math assessment.

Demonstrated Promise: In summary, we found that greater use and topic coverage in StepWise correlated with larger classroom level learning gains. These results together indicate StepWise is a promising educational learning tool that has potential to improve academic achievement.