Why Gizmos Work

Meta-analysis of educational research (Marzano, 1998) identifies several instructional techniques that have a strong positive impact on student achievement. ExploreLearning math and science Gizmos bring these powerful and effective instructional techniques to the classroom.

In findings from over 100 research studies involving 4,000+ experimental/control group comparisons, the following were all shown to have an average effect size greater than 1 (i.e., a percentile gain of more than 34% in students' achievement):

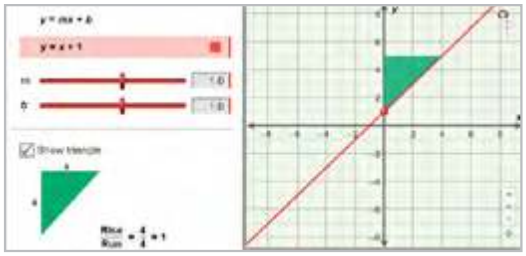
1. Representing new knowledge in graphic/nonlinguistic formats

Research in cognitive psychology indicates that our brains store knowledge using both words and images, and instruction that targets and engages both has been shown to significantly increase students' comprehension and retention.

The Gizmos in the ExploreLearning library cover hundreds of topics in math and science with interactive visual models. For example, Gizmos help students visualize the flow of current in an electrical circuit they have designed themselves, study the process of triangulation in determining an earthquake's epicenter, and identify the role of the sun and moon in the fluctuation of ocean tides.

In the **Phases of the Moon Gizmo**, students can see the position of the moon relative to Earth and the sun on one side, and the moon phase on the other. An additional graphic shows exactly which part of the moon is visible from Earth. As the moon goes around, the cause of phases quickly becomes apparent. Throughout the Gizmo library you will find a multitude of unique interactive simulations and animations that help students understand concepts that are difficult to describe or visualize.

2. Using manipulatives to explore new knowledge and practice applying it



Manipulatives are concrete or symbolic artifacts that students interact with while learning new topics. They enable active, hands-on exploration of abstract concepts. Research has shown that computer-based manipulatives are even more effective than ones involving physical objects, in part because they can dynamically link multiple representations together. For example, students learning about systems of linear equations can use Gizmos to manipulate lines and instantly see the results of their actions as each of the multiple representations algebraic, tabular, graphical) updates in real-time.

The **Slope-Intercept Form of a Line Gizmo** gives students a dynamic graph of a line, along with its equation, $y = mx + b$. Students can use sliders to change the values of m and b, and watch how these changes affect the line. Or, they can manipulate the line itself and see the values of m and b change. By seeing the connections between equation and graph, in real time, students can figure out what each value in the slope-intercept form of a linear equation, $y = mx + b$, means. A table of (x, y) values provides a third representation. When students understand how these three things – equation, graph, and table – are connected, they really understand the concept.

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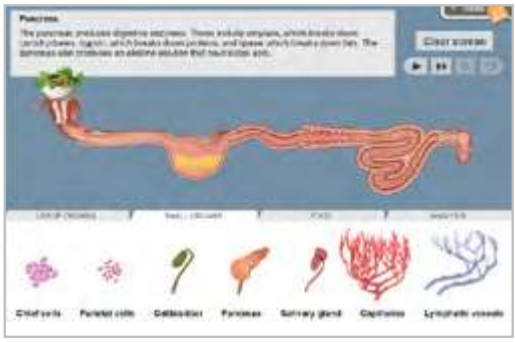
3. Generating and testing hypotheses about new knowledge

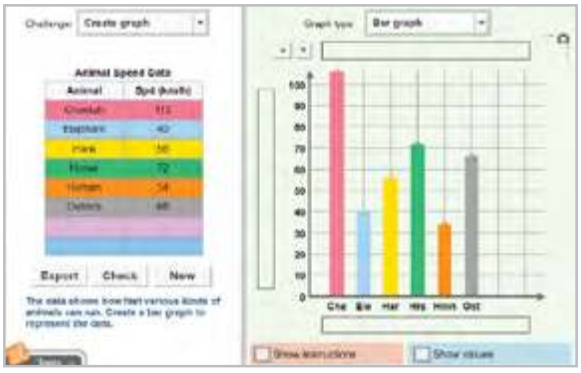
Research has shown that students derive the greatest value from manipulatives when they are guided in their use. The full pedagogical power of the manipulative is only achieved when students mindfully reflect on the actions they perform and how the manipulative responds to them.



The guides that accompany every Gizmo are designed to support and stimulate this type of mindful interaction. A typical guide starts with students engaging in a set of exercises where they perform specific actions and record the results. Then, they are prompted to make predictions about new situations, after which they verify their answers using the Gizmo.

The **Digestive System Gizmo** allows students to test hypotheses in a unique way. Students can arrange the organs of the human digestive system in any configuration, then measure how well different nutrients (carbohydrates, proteins, and fats) are digested and absorbed. By carefully comparing similar systems, students can test hypotheses about the function of each organ and optimize its placement in the system. At the end of the lesson, students can compare their systems to the actual human digestive system. This opportunity to experiment and test hypotheses in an open-ended environment is unique to Gizmos.

4. Direct presentation of new knowledge



The Marzano meta-analysis notes that students learn effectively and efficiently when new concepts are first taught directly to them, after which they practice applying the concepts on their own. Ideally, educational software should support teachers in presenting new knowledge to students, and then should support students in applying and extending what they have learned on a more individual basis.

Graphing is an essential skill for all students, and understanding how to create and interpret graphs is helpful in many professions.
The **Graphing Skills Gizmo** allows students to create graphs based on data tables (and vice versa) and then check that accuracy of their work. Graphs range from very simple line and bar graphs to more complex scatter plots and pie charts. The user-friendly format and feedback allow students to quickly master the essentials of graphing.

Dig Into the Details

To read the full study, Why Gizmos Work: Empirical Evidence for the Instructional Effectiveness of ExploreLearning's Interactive Content, go to gizmos.explorelearning.com.