Benefits of Thinking Tools

Research shows value of visual representation

Intel® Education thinking tools are based on research that demonstrates the value of visual representation in constructing and retaining new information. Thinking tools use technology to allow students to convey and exchange ideas, actively construct knowledge, solve problems, and create nonlinguistic representations of what they have learned. During a course of study, students modify these representations to show their growth in understanding over time. This process helps teachers gauge student understanding and also helps students direct their own learning.

Intel developed the thinking tools in collaboration with leading cognitive scientists and experienced classroom teachers. This combination of theory and practice translates to benefits for teaching and learning.

As the National Council of Teachers of Mathematics explains in Principles and Standards for School Mathematics, students gain in understanding when they use representations to model and interpret physical, social, and mathematical phenomena. Representations allow students to communicate mathematical approaches, arguments, and understanding to themselves and to others. Representations also help students recognize connections among related concepts and apply mathematics to solving realistic problems. (NCTM, 2000)

Research tells us about:

Value of graphic representations

Creating graphic representations of what has been learned helps students store knowledge and enhances their understanding of content. Students benefit from both linguistic and nonlinguistic systems of representation. However, the primary way new information is presented in the classroom is linguistic, delivered through lectures or readings. When teachers help students generate nonlinguistic representations of what they are learning, achievement increases. Indeed, the more students use both systems of representation--linguistic and nonlinguistic-the better they are able to think about and recall knowledge. (Marzano, Pickering, & Pollock, 2001)

- ***Engaging the learner's brain:*** Explicitly engaging students in the creation of nonlinguistic representations stimulates and increases activity in the brain. (Gerlic & Jausovec, 1999)
- ***Importance of feedback:*** When students create graphic representations during a project, they give teachers a window into their understanding at different points in the learning process. This creates timely opportunities for teacher feedback, which researchers have found to be a powerful factor for enhancing achievement. (Hattie, 1992)
- ***Finding patterns:*** Tools that make use of visualization prompt students to engage the human visual system to find patterns and organize ideas. (Edelson, Brown, Gordin, & Griffin, 1999)

The thinking behind our tools

See what a researcher, a teacher, and a Web tool developer say about the value of using interactive thinking tools in the classroom:

Researcher's view:

Cognitive scientist Matthew Brown says, "These new learning tools give students the potential to be actively constructing knowledge, building things, and creating things in a way that no other media have been able to support in the past. Technology offers the opportunity both to convey ideas and to allow for the construction of ideas. That's a huge opportunity."
Read more ›

Teacher's view:

Ariel Owen, a sixth-grade science teacher, describes what she and her students have gained from using a causal mapping tool. An interactive resource like the Seeing Reason Tool, she says, "is a terrific tool for focusing and expressing students' thinking. For students having a difficult time in science, this mapping project helps illustrate relationships in a very visual and tactile way."
Read more ›

Developer's view:

Dr. Jim Pollard, Intel's lead researcher for developing these online educational tools, has specific learning goals for what interactive thinking tools should accomplish. "Our tools are based on cognitive research that shows how kids think," explains Pollard.
Read more ›

References

Edelson, D., Brown, M., Gordin, D., & Griffin, D. (1999, February). Making visualization accessible to students. GSA Today 9(2), 8-10.

Gerlic, I., & Jausovec, N. (1999). Multimedia: Differences in cognitive processes observed with EEG. Educational Technology Research and Development, 47(3), 5-14.

Hattie, J.A. (1992). Measuring the effects of schooling. Australian Journal of Education, 36(1), 5-13.

Marzano, R., Pickering, D., & Pollock, J., (2001). Classroom instruction that works. Association for Supervision and Curriculum Development: Alexandria, VA.

National Council of Teachers of Mathematics. (2000). Principles and standards for school mathematics. Reston, VA: Author.