Research into Practice. From Solving Problems to Problem Solving

Article

Think back to elementary school math class. Chances are you used flashcards to memorize math facts and added zeros as placeholders when multiplying. You may even have lost points when you didn't show your work. Elementary math classes look different these days. Rather than memorizing facts, students are taught to use a variety of strategies when they encounter a math problem. We learned that 3x4=12. Today's students know why 3x4=12 and they can show you more than one way to arrive at that answer. They've moved from solving problems to problem solving.

Problem solving requires "learners work through a process that demands both retention and transfer of new knowledge" (Akcaoglu and Green 2018, p. 3).

This is key.

Retaining new knowledge and being able to apply it to a new situation is the textbook definition of meaningful learning (Mayer and Wittrock 2006). Problem solving is the ideal situation for this process because "problems are not equivalent, in content, form, or process" (Jonassen 2000, p. 65). Now, before you start questioning the benefits of problem solving by visualizing that third grade math worksheet, we should probably clarify that problems come in different forms. These can easily be separated into two large groups: well-defined (typically problems with a "right" answer) and ill-defined. Ill-defined problems, or complex problems, are open-ended. These are problems where the goal, the solution, even the pathways to that solution are not clear or immediately obvious to the problem-solver. Often, there may not even be a "right" answer (Akcaoglu and Green 2018).

What do we know about preparing children to become successful complex problem solvers? Well, there is a body of research among instructional technologists and cognitive psychologists that has identified **systems thinking** as a set of skills that can help us successfully tackle and solve complex problems.

Can the systems thinking skills necessary for complex problem solving be taught? Yes. Can these be taught in creative and engaging ways? Yes. Can these skills be addressed in school library programming? Absolutely! Programs that provide students with opportunities to create and design are optimal venues for fostering systems thinking and complex problem solving skills. Many libraries are investing in makerspaces and starting coding clubs. However, when these activities go beyond the item being made, they become much more than just the latest trend. Erica de Vries (2006) and Fengfeng Ke (2014) argued that design tasks help learners develop systems thinking in authentic ways—using real-world skills to investigate, implement potential solutions, reflect on the process, and communicate their solutions to others.

As an example, designing digital games using programs like Scratch or Kodu can be extremely beneficial in teaching "systems thinking, problem solving, critical and creative thinking, storytelling, programming, and visual literacy" (An 2016, p. 565). Imagine everything a student must consider to design a game and it makes sense that this activity would reap rich cognitive rewards. Not only must a student develop a world, but he or she must establish rules, determine how these rules interact with each other, decide how these rules respond to a player's decisions, and figure out how to evaluate if their world behaves logically and appropriately, all while trying to fit his or her original design vision into the constraints of the design software. While not as extensively studied, other design based tasks such as creating and editing videos, creating original knitting patterns, even generating recipes from scratch could potentially provide similar benefits (Green, Inan, and Maushak 2014).

Further Reading

Thanks to Dr. Melissa Johnston for curating these additional resources as part of her involvement in ALA Ready to Code.

Exploring Computational Thinking https://edu.google.com/resources/programs/exploring-computational-thinking

Computational Thinking for Educators https://computationalthinkingcourse.withgoogle.com/unit

ALA Ready to Code https://www.youtube.com/watch?v=vFBZz9_TVXc

Works Cited

Akcaoglu, Mete, and Lucy Santos Green. "Teaching Systems Thinking through Game Design." *Educational Technology Research and Development* (2018). doi.org/10.1007/s11423-018-9596-8

An, Yun-Jo. "A Case Study of Educational Computer Game Design by Middle School Students." *Educational Technology Research and Development* 64, no. 4 (2016):

555-571.

de Vries, Erica. "Students' Construction of External Representations in Design-Based Learning Situations." *Learning and Instruction* 16 (2006): 213-227.

Green, Lucy S., Fethi Inan and Nancy Maushak. "A Case Study: The Role of Student-Generated Vidcasts in K-12 Language Learner Academic Language and Content Acquisition." J*ournal of Research on Technology in Education* 46, no. 3 (2014): 297-324.

Jonassen, David H. "Toward a Design Theory of Problem Solving." *Educational Technology Research and Development* 48 (2000): 63-85.

Ke, Fengfeng. "An Implementation of Design-Based Learning through Creating Educational Computer Games: A Case Study on Mathematics Learning During Design and Computing." *Computers and Education* 73 (2014): 26-39.

Mayer, Richard E. and Merlin C. Wittrock. "Problem Solving." In Patricia A. Alexander & Phillip H. Winne (Eds.), *Handbook of Educational Psychology.* Lawrence Erlbaum Associates, 2006: 287-303.

MLA CITATION

Green, Lucy Santos, and Michelle Maniaci Folk. "Research into Practice. From Solving Problems to Problem Solving." *School Library Connection*, January 2019, schoollibraryconnection.com/Content/Article/2184542.

https://schoollibraryconnection.com/Content/Article/2184542?topicCenterId=1945913

Entry ID: 2184542