NEWSLETTER

How to Design Graphical Scaffolds to Support STEM Teaching Effectively?

By Cai, H., Dong, H., & Wang, Q.
Correspondence to: Huiying Cai, Associate Professor, Research Center of Educational Informatization, Jiangnan University, China. Email: caihy@jiangnana.edu.cn

A META-ANALYSIS study published in *e-Education Research* was conducted to explore the effectiveness of the graphical scaffolds in the teaching of STEM courses by in-depth, analyzing 30 experimental and quasi-experimental studies.

The research findings are as follows:

- Graphical scaffolds have a moderately positive effect on learners' learning in STEM courses. It can not only improve learners' cognitive perception and academic motivation but also reduce cognitive load and improve learners' abilities of spatial representation and problem-solving. However, graphical scaffolds in STEM courses have no significant positive effect on learners' metacognitive ability and self-efficacy.
- Visualize information, knowledge structure, dynamic knowledge, thoughts, learning process, and graphical scaffolds have different positive effects on improving students' results in STEM courses. The factors above show a moderately positive effect on the shallow and deep understanding of learners, and they can reduce the cognitive load of learners.
- From the perspective of the learning phases, the integration of graphical scaffolds in the STEM curriculum has a relatively strong impact on students' learning in elementary and high school, a moderate impact on it in junior high school, and a low impact on college students. From the perspective of subjects, the integration of graphical scaffolds in STEM courses has a moderately high impact on the learning of mathematics and engineering courses, and a moderate impact on the learning of technology and science courses. From the perspective of teaching methods, compared with project-based learning and problem-solving learning, inquiry-based learning, and collaborative learning have a positive impact on learners' learning results.

- Research implication: First, teachers should consciously design graphical scaffolds to improve the cognitive, skill, and emotional aspects of learning quality. Second, teachers should design graphical scaffolds in a personalized way. On the one hand, teachers should design graphical scaffolds by consideration with the emphasis of learning goals. Thirdly, teachers can design graphical scaffolds to structure collaborative inquiry instruction pertinently by analyzing the characteristic of domain-specific knowledge and learners.

Source: e-Education Research, 2020; 41(10): 73-81.