Supplemental Computer-Aided Instruction in Mathematics

Research Summary

The Idaho State Department of Education provides a variety of tools that can increase a student's opportunity to achieve academically at a high level. This research summary specifically discusses computer-aided instruction that supplements classroom instruction to increase a student's success in learning mathematics. This document is a resource for districts, schools, and teachers as they consider utilizing a supplemental computer-aided instruction program to enrich their classroom mathematics instruction.

Supplemental Computer-Aided Instruction

Educational technology is seen in many different forms. In this discussion, we define computer-aided instruction as a program that gives instruction, receives student response and provides immediate feedback to the student. We specify the use of supplemental computer-aided instruction as enhancing, rather than replacing, core mathematics instruction.

The Effect of Utilizing Computer Technology in the Math Classroom.

Utilizing computer technology to support mathematical instruction is not a novel or new occurrence. Although the computer technology implemented took a variety of forms, this practice grew in the 1990s and early 2000s. A meta-analysis of 85 studies spanning these decades found the impact of using computer technology in the classroom resulted in a statistically positive effect on math achievement scores. (Li & Ma, 2011). This study and those that followed illustrated that there are factors to consider in the type of computer technology being used and in the classroom in which it is being utilized.

A second meta-analysis by Cheung and Slavin (2013) reiterated that using technology in the math classroom had a modest positive effect on math achievement. This research parsed into different categories of computer technology and concluded that computer-assisted instruction had a greater positive effect than other specified categories. In addition, computer-assisted instruction used as a supplement to core instruction, rather than as the core component showed the greatest effect. Further research has concluded that the effect of such programs is maximized when students are given frequent opportunities to respond and are provided with immediate feedback (Hawkins, et al. 2017).

Beyond the type of program being utilized, the core instruction in the classroom influences the desired impact, as well. The positive effect on math achievement was greatest in classrooms in which the teacher approached mathematical understanding with a constructivist philosophy, building

understanding through inquiry, experience and discovery; as opposed to other pedagogical approaches (Li & Ma, 2011). Students' current mathematical skills don't seem to limit these positive effects. Students labeled with severe skill deficits and at-risk of failure have shown gains in mathematical understanding after using a supplemental computer-assisted instruction (Burns, 2012;) Rich et al. (2017) concluded that computer assisted instruction can have a positive effect on math fact fluency.

Recommendations for Implementation

There are many factors to consider when using supplemental-aided instruction to support core math instruction. The first being the quality of the core math instruction. As the research supports, classrooms using effective pedagogical practices to build student's understanding of concepts and procedures set the stage for impactful use of technology in the classroom. In a classroom that uses instruction to support students' ability to make sense of mathematical concepts and reason mathematically, technology can be a powerful tool to further these efforts (NCTM, 2015).

Ideally, supplemental computer-aided instruction is used strategically within these effective teaching practices. Students' work with technology should not be used in isolation. Instead, students need to collaborate and communicate their understanding of the math concepts and procedures they encounter in using technology. Whether a small group of students that encounter the same concepts or the whole classroom, having students talk about the math they learn is highly encouraged. Teachers can use the tasks and problems encountered in supplemental computer-aided instruction to facilitate rich mathematical discussion, encouraging a depth of understanding of the concepts students encounter. Utilizing tools within various programs to have students model mathematical concepts and express understanding furthers the potential for collaboration (Dick & Hollebrands, 2011).

Many supplemental computer-aided instructional programs make an abundance of data available to teachers. These data can be a powerful tool to monitor students and assess student learning. Teachers are encouraged to use these data to plan and differentiate core instruction in their classrooms. This should be done with an understanding that these are some of many data points to consider when making these instructional decisions. These data should not be used to track students into different leveled classes, as tracking itself is discouraged practice. (NCSM, 2020).

The class time allotted for supplemental computer-aided instruction should also be done judiciously. Due to the scarcity of instructional time, carefully planned implementation is necessary for the supplemental computer-aided instruction to not detract from core instruction. Not only how much use, but also where this supplemental computer-aided instruction fits in the planned sequencing of conceptual instruction is essential to its effectiveness.

While the research in this field is preliminary, utilizing computer assisted programs for mathematics instruction has the potential to improve student mathematics achievement most effectively when it is paired with high-quality core instruction.

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