Virtual Manipulatives

Why Is This Strategy Useful?

Manipulatives are increasingly common in mathematics classrooms, and with computer technology students can now manipulate “virtual” objects on the computer screen. These objects, referred to as virtual manipulatives, are essentially replicas of physical manipulatives, readily available on the Internet for teachers' use. Past research has shown that the use of physical manipulatives in the teaching and learning of school mathematics produces positive achievement results. Recent studies indicate that virtual manipulatives are an innovative and useful way to enhance mathematics teaching. This strategy is best-suited for elementary and middle school students of all abilities.

Description of Strategy

In order to effectively use virtual manipulatives in the classroom, teachers must have an understanding of how to use representations for mathematics instruction as well as an understanding of how to structure a mathematics lesson where students use technology. Teachers must also be comfortable with technology and be prepared for situations where computers may not be available or Internet connections are not working properly. Moreover, students learn best when teachers use multiple instructional strategies that combine "see-hear-do" activities. Manipulatives increase exploration possibilities to develop concepts and test hypotheses for students at all levels of ability. Many virtual manipulative applets are available on the World Wide Web on web sites such as the National Library of Virtual Manipulatives (http://matti.usu.edu/nlvm) or the National Council of Teachers of Mathematics electronic resources (http://www.nctm.org).

Research Evidence

At least one quasi-experimental study supports the use of this strategy. The purpose of this study was to examine how the use of the virtual manipulatives might enhance students' learning of fractions beyond what students had learned through the teacher's use of physical manipulatives and other instructional strategies. Nineteen third-grade students participated in this study. Virtual manipulatives use occurred during a two-week time frame during regular school hours. Students participated in the activities in the project during their regularly scheduled mathematics class sessions. Conceptual knowledge assessment showed significant gains for the students using virtual manipulatives. Findings also indicated that virtual manipulatives were easier and more efficient to use than paper-and-pencil methods.

Sample Studies Supporting this Strategy


With recent advances in computer technology, it is no surprise that the manipulation of objects in mathematics classrooms now includes the manipulation of objects on the computer screen. These objects, referred to as virtual manipulatives, are essentially replicas of physical manipulatives placed on the World Wide Web in the form of computer applets with additional advantageous features. The purpose of this project was to explore the effects of using several virtual manipulative computer applets for instruction during a fraction unit in a third-grade classroom. The participants in this study were 19 third-grade students. During a two-week unit...
on fractions, students interacted with several virtual manipulative applets in a computer lab. Data sources in the project included a pre- and post-test of students’ conceptual knowledge, a pre and posttest of students’ procedural computation skills, student interviews, and a student attitudes survey. The results indicated a statistically significant improvement in students’ posttest scores on a test of conceptual knowledge, and a significant relationship between students’ scores on the posttests of conceptual knowledge and procedural knowledge. Student interviews and attitude surveys indicated that the virtual manipulatives (1) helped students in this class learn more about fractions by providing immediate and specific feedback, (2) were easier and faster to use than paper-and-pencil methods, and (3) enhanced students’ enjoyment while learning mathematics.

Sample Activity


This manipulative is particularly useful for independent practice with illustrating fractions, or for teacher-directed practice in associating a fraction statement with a graphic and numeric representation.

Students should understand that fractions are one way to describe parts of whole units.

Students can highlight sections of the picture and see a written description and the fraction representation.

Teachers can also describe a part of a whole unit and have the student generate an appropriate fraction for that statement. For example, if a teacher states, "three out of five parts needed to make a whole unit" a student would use the arrow keys to show five parts and highlight three of the five parts.

Practice the representation activities with physical manipulatives. For example, have students hold up three of the five crayons on their desk. The teacher can also identify a fraction and have students provide an appropriate example.

Can students accurately describe their illustration using words? For example, when highlighting 1/3, the user will state, "One out of three parts needed to make a whole unit."
When given a statement like "three out of four parts needed to make a whole unit," the student will highlight an appropriate number of parts.

**Additional Resources**

Virtual Manipulatives. http://otec.uoregon.edu/virtual_manipulatives.htm