Research Question

How does visual programming affect the academic outcomes of multiplication and division for third-grade students?

Hypothesis

Visual programming can increase understanding of multiplication and division in third-grade mathematics. Success in visual programming activities is a good indicator that students understand the concepts of division and multiplication. Visual programming can provide more appropriate transitions from one mathematical concept to a more advanced one.

Methods

Due to the small sample population size and the scope of the study, we don't expect the study to be statistically significant. However, we do expect that it can provide insight for future studies. The study will be carried out during the USU Spring 2021 semester.

Organization

The study will be divided up into programming activities. Each programming activity will have focused learning objectives on learning a core education standard. Similar to homework assignments, activities will be completed by each student in the study. One or two assignments will be given each week, or every day that a new multiplication or division topic is taught.

Gathering Data

The study will have a control group and a test group, preferably taught by the same teacher.

Quantitative data will be gathered at various points during the study.

Before the study students will participate in a pre-test. The purpose of the pre-test is to evaluate where each student stands and if they are meeting the current standards.

Before each activity in the study, a short questionnaire will be given.

During the activities, we can gather other various forms of data. These may include the total time it takes for the student to complete the activity, the total number of blocks that they use to complete the activity, the total number of blocks they drag onto the canvas but don't use, the number of times they run the compiler and observe the program running, their final code block solution, and whether or not they successfully completed the activity among other things. This data can be used both for observing the performance of a single activity and activities over time. If students take much longer than expected it may mean that there are flaws in the programming environment.

After each activity students will complete a second questionnaire for them to reflect on what they learned and to see how they felt about the activity. Coupled with pre-activity evaluations we may see trends.

After the study is complete a post-test will be given to determine if students met the learning objectives.

Qualitative data may include written feedback from the teacher, parents, or the student. This can give us general insight on the study overall.

Study Outline

Pre-test: The pre-test can:

1. Give us a starting point. It will give us information about how students are performing in math before the intervention.
2. Act as a survey to gather general information about their prior coding experience, demographic data, or other information that we may find helpful to the study.

Example 1.

Pre-Activity: The pre-activity gives us an idea about how the student feels before completing the activity. A question here may be:

> How do you feel about repeated addition?
>
> 😕 😐 🙂

Activity: The activity would then start from a topic on repeated addition. Each activity may be divided into several problems. For example:

> **Learning objective***:* Help students understand the concept of grouping and repeated grouping.
>
> **Standard 3.OA.1** Interpret the products of whole numbers, such as interpreting 5 × 7 as the total number of objects in 5 groups of 7 objects each.

1. Tell the computer to draw 5 circles.
2. Tell the computer to draw 5 circles using the repeat block.
3. Tell the computer to draw 7 circles using the repeat block
4. Tell the computer to draw 7 circles 7 times using two repeat blocks.
5. Tell the computer to draw 7 groups of 5 circles where each group of circles is a different color.
6. How many circles do we have total? How many circles are there if we have 7 groups of 5 circles?

Post-Activity: The post-activity allows the student to reflect on their learning.

> How hard was it to tell the computer to do our math?
>
> 😕 😐 🙂
>
> Did you learn anything new?
>
> 👎 👍
>
> (Followed possibly by a “What was hard?” or “What did you learn?”)

Example 2.

Pre-Activity: The pre-activity gives us an idea about how the student feels before completing the activity. A question here may be:

How do you feel about division?

😕 😐 🙂

Activity: The activity would then start from a topic on repeated addition. Each activity may be divided into several problems. For example:

Learning objective*:* Given a product, help students determine the appropriate factors to make divide the product into equal-sized groups.

Standard 3.OA.2 Interpret whole-number quotients of whole numbers

Standard 3.OA.3 Use multiplication and division within 100 to solve word problems in situations involving equal groups, arrays, and measurement quantities

1. Tell the computer to draw 15 items (The computer draws all of the items in a single row)
2. Tell the computer to draw each item on a different row.
3. Tell the computer to draw two items on each row. (The computer points out that it can't finish the last row).
4. Tell the computer to draw three items on each row.
5. Using your program, determine how many different combinations divide 15 into equal rows.

Post-Activity: The post-activity allows the student to reflect on their learning.

How hard was it to tell the computer to do our math?

😕 😐 🙂

Does dividing items into equal groups seem easier?

👎 👍

(Followed possibly by a "Why?")

Post-test: the post-test will cover the same topics and concepts as the pre-test in addition to other topics that cover what was taught during the intervention. It can also give an opportunity for any other feedback about the study.