Office of Professional Learning

— January 2025 Education Bulletin —

Welcome to the January 2025 edition of the **Luzerne Intermediate Unit (LIU) Office of Professional Learning's (OPL)** monthly education bulletin. The intent of this communication is to provide subscribers with:

- Professional learning opportunities offered by our department,
- Provide school leaders with educational policy support, and
- Provide tips for practicing educators.

This special edition of the OPL Education Bulletin is part III of a four part series dedicated to all of the teachers that teach mathematics in grades K—5. We hope this issue gives you a few ideas to dig into to improve your practices.

Don't forget to subscribe to the OPL Education Bulletin!!!

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Why Elementary Math? - Part III

Math Teaching Pedagogy - Word Problems

Student assessment data reveals areas where instruction can benefit from incorporating research-based practices. While many factors contribute to a student's mathematical struggles, many of these lie beyond a teacher's control. A focus on specific, effective instructional practice can be controlled. We encourage you to consider the following strategies with the hope that they will expand the number of tools in your "instructional toolbox".

- **Part I: Student Readiness using the Instructional Hierarchy Framework**
- **Part II: Interleaved Mathematical Practice**
- **Part III: Solving "Word Problems" using Schema-Based Instruction in Lieu of Keywords**
- **Part IV: Student Mimicking versus Student Thinking**

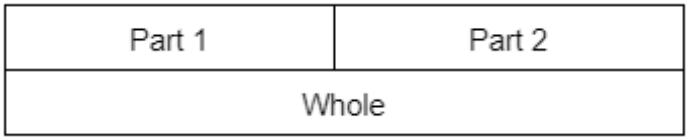
In this edition, the focal instructional technique is the concept of using schema-based instruction in K-5 Mathematics. Schema-based problem solving is a strategy that teaches students to identify problem types by focusing on the underlying structure of the mathematical situation. These structures are used to characterize these types so that students can better retrieve strategies to solve them. This instructional format is derived from Schema Theory that posits that the brain organizes units of knowledge about a given subject or event based on clusters of related information. It allows us to form and use cognitive blueprints or schemata to store and retrieve ideas.

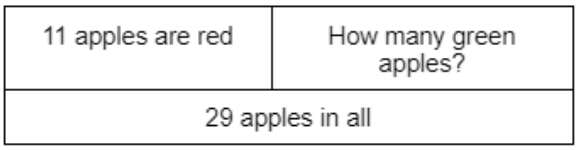
How Does it Work?

Implementation of Schema-Based Instruction

First, ditch practices that skirt around the goal - equipping students to truly solve authentic mathematical problems. For example, many classrooms post a list of keywords for their students to use as they navigate word problems. The "keywords" strategy circumvents problem-solving by asking students to associate an operation with a specific word. The concern is that it is a fallible protocol - especially in problem scenarios that are multistep. A research study conducted in 2022 of over 700 questions from high-stakes standardized assessments found that a keyword strategy approach met with 50 percent accuracy on single-step problems and only 10 percent in multistep problems.

In a schema-based approach, students are explicitly taught to identify different types of word problems based on specific characteristics, which allows them to choose the correct operation to solve the problem. This is done by providing students with scenarios that have common structures that suggest the use of an operation. For example, Part-Part-Whole is an additive schema. Here, students must be taught to recognize the presence of two parts of a situation that must be added to create a whole.





Lyle has 29 red and green apples. If 11 of the apples are red, how many green apples does Lyle have? Here there are no keywords to help a student solve this problem. However, if the student is taught to recognize that 29 apples is the whole and that red and green apples are the parts, they can apply this additive schema to solve this problem. Often, it is best to use graphic organizers to support student learning of the concept.

The following will provide some examples of different schemata often present in the elementary grades.

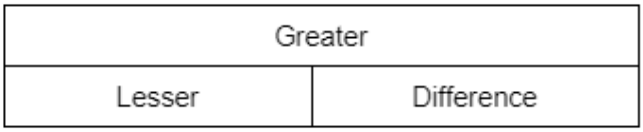
Additive Schema

Schema-Based Addition and Subtraction

A benefit of the additive schemata is that it addresses situations that require addition and subtraction. For example, the **Part-Part-Whole** schema asks for addition when the whole is unknown. However, if a part is unknown, subtraction is employed. Many of these also use a similar graphic organizer like the one shown above. Here are some common schema that students in early grades can learn:

Difference is a schema that is pretty obvious. It manifests in several different was - each of which should be explicitly taught.

(1) **Difference Unknown**: We use this schema when comparing two distinct sets. The sets cannot be combined, and a third set for the whole or total does not exist. Gillian has 9 red counters and 5 yellow counters. How many more red counters than yellow counters does she have?



(2) **Bigger/Greater Unknown:** Here, a larger quantity is asked to be found. For the yearly reading competition, Grade 3 read 547 books. The Grade 5 class read 705 books more than Grade 3. How many books did Grade 5 read?

Grade 5 read more books.	
Grade 3: 547 books	705 books difference

(3) **Smaller/Lesser Unknown**: Similar to the previous schema, however a smaller quantity is asked to be found. Kate has $11. This is $4 more than Jim. How much money does Jim have?

Kate = $11	
Jim $	$4 dollars difference

Change is another strategy that falls under the umbrella of additive schema. We use the change model when the situation includes an increase or decrease in a set over time. This schema can present itself with the initial quantity, the change, or the final quantity as the unknown.

Start	+/-	Change	=	End

(1) **Initial Quantity Unknown:** The teacher directed the students to each take 5 more red counters. Gillian picked out 5 more red counters. Now he has 18 red counters. How many red counters did he have before the teacher's directions?

(2) **Change Unknown:** On a test, Felicia scored a 94. Her teacher let her do corrections to gain points back. After corrections, she scored 135 points. How many points did Felicia improve her score from corrections?

(3) **Result Unknown:** Kate brought $3.60 in her pocket for school lunch. Her pants pocket had a hole in it, and $0.40 dropped out in the grass during recess. How much money does Kate have for lunch?

Yes, there is a lot presented here. However, know that each of these additive schema relate back to a source model. For nearly all of addition and subtraction, problems can be boiled down to one of these three basic diagrams? Consistent use of these both within and across grades help students with operational thinking no matter the values involved. Large numbers or decimals requiring use of place value, positive and negative integers, and even fractions fit into these schematic models based on the context of the scenario they are used.

Part-Part Whole Model

Part 1	Part 2
Whole	

Difference Model

Greater	
Lesser	Difference

Change Model

Start	+/-	Change	=	End

More Schemata

Going Beyond the Additive Schema

While the additive schema support the operations of addition and subtraction, multiplicative schema supports problem scenarios that include multiplication and division. These include equal group and comparison problems. Equal groups manifest when the solution suggests repeated addition of a group to form a product. Comparison asks to calculate a product of two quantities related by a multiple or "number of times". Besides benefits to problem solving, research also shows that the use of schematic strategies supports students acquisition of proportional thinking. This concept is the gateway to student understanding of rates of change, a pervasive topics threaded through all middle and high school mathematics courses. I encourage you to delve deeper into the beneficial and critical aspects of schema-based instruction and employ these practices in your math classroom.

What's Happening?

Find and Register for LIU Events

There is a lot going on at the Luzerne Intermediate Unit in 2025. If you are interested in learning more about the many opportunities we offer, please visit our Event Registration page (https://www.liu18.org/event-registration/). Here you can browse all activities open for enrollment and register for Continuing Professional Education (CPE) courses. We update our list of events weekly. So, check this resource out often. Also, if you are interested in professional learning not present in our program roster, please reach out to our team and put in a request for a specific topic.

Past OPL Bulletins

Where Can I Find them?

All prior OPL Education Bulletins can be found on our LIU website. Our website address is www.liu18.org. From here, select "District Services" under the "Departments" dropdown. This space will provide you with information about our professional group. Select the "Office of Professional Learning" and then head down the page to "OPL Education Bulletin". Prior to doing so, feel free to look around any of the other informational items on this page like Assistive Technology, Career Development, the Guest Teacher Program and many more. See you next month.

OPL Education Bulletin

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