Promoting Inclusive Mathematics Instruction through Logical Truth Tables and Coding in Integer Operations

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Abstract

Integer operations form the foundation of mathematical learning. However, due to persistent misconceptions of positive and negative numbers with respect to additive inverse, addition and subtraction, multiplication and division and misinterpretation of inequalities symbols, students are constrained in solving problems accurately and confidently. Traditional teaching strategy via rote memorizations fails to adequately address these challenges. This paper presents Inclusive Mathematics Instruction through Logical Truth Tables and Coding in Integer Operations as an innovative strategy. Widely used in logic and computing as a structured, visual framework for analyzing all possible outcomes of mathematical operations, mapping positive and negative integers in tabular forms makes the underlying rules more transparent, reduces reliance on memorization, and fosters inclusive learning for diverse students' abilities. The paper concluded that the use of truth tables and coding-based logic concepts in teaching integer operations promises dual benefits as: bridging the gap between abstract logical reasoning and concrete mathematical application; and provides an inclusive strategy (logic-based teaching strategy) that reduces reliance on rote memorization. It was suggested that the application of truth tables and logical coding systems should be actively promoted and thoughtfully incorporated to strengthen the teaching and learning of integer operations.

Keywords: Integer operations, Integer signs, Inequalities symbols, Logic-based teaching strategy, Traditional teaching strategy

Word Count: 194

Introduction

Mathematics remains a fundamental pillar in the Nigerian educational system, particularly at the Upper Basic Education level (Primary 5 to Junior Secondary School 3), where learners engage with foundational concepts such as integer operations, inequality symbols, and logical reasoning. Promoting inclusivity at this stage is essential, as classrooms consist of learners with diverse abilities, learning needs, and levels of prior understanding. In response, logic-based teaching strategy such as the use of truth tables and logical coding structures offer a structured and accessible approach that supports all learners by simplifying abstract ideas, clarifying relationships among integers, and enhancing conceptual understanding. This inclusive orientation strengthens learners' confidence, reduces misconceptions, and ensures that mathematical learning is equitable and meaningful for every student. These concepts serve as the building blocks for higher-level mathematical problem-solving. Integer refers to a set of positive and negative whole numbers as well as zero; that is, $\mathbb{Z} = \{\ldots -3, -2, -1, 0, 1, 2, 3 \ldots\}$ (Kwakye, Alphaa, Agyei, Larbi, Anane & Domonaamwin, 2022). These numbers can be represented on a number line extending infinitely in both directions from zero, where each integer denotes a specific magnitude (distance from zero) and a direction either positive or negative. The term "integer" originates from Latin, meaning whole or complete (Gyampoh, Nyarko & Agyeman, 2020; Kwakye et al, 2022).

Basic mathematical operations on integers are addition (+), subtraction (–), multiplication (×) and division (÷) which serve as building blocks for understanding broader mathematical concepts, especially those related to reasoning and word problems. These operations extend beyond simple arithmetic, encompassing essential properties such as commutative, associative, and distributive laws, which are fundamental in both mathematical theory and real-world applications, including physics and computer science (Anggraeni, Andayani & Rahmawati, 2025). A solid grasp of these principles is crucial in developing learners' logical reasoning and analytical thinking abilities.

Misconceptions and Misinterpretations of Basic Mathematical Operation Signs and Rules

Despite the foundational importance of integer operations in Mathematics, a significant number of students continue to experience persistent difficulties and misconceptions that hinder their conceptual understanding and problem-solving abilities. Research has consistently shown that learners struggle with both the procedural and conceptual aspects of integer operations, including addition, subtraction, multiplication, and division, especially when dealing with signed numbers and unfamiliar problem formats. These challenges are often compounded when students attempt to solve word problems, where difficulties in interpreting mathematical language, modeling relationships, and selecting appropriate strategies frequently result in incorrect answers or abandonment of tasks altogether (Rosyidah, Jiwandono, Oktaviyanti & Gunawan, 2021; Harun, Cuevas, Sagdi, Sapilin, Nasilon, Kadil, Alviar & Solon, 2024).

Misconceptions identified in various studies range from misinterpreting signs and operational rules to committing errors due to carelessness or incomplete understanding of mathematical principles. These misconceptions are evident in students' inability to distinguish when to apply correct operations or to handle expressions involving multiple operations. Common errors include confusion with negative signs, misapplication of order of operations and procedural errors in subtracting or dividing integers with unlike signs. These learning gaps contribute to underperformance in Mathematics and inhibit the development of logical thinking skills required for advanced learning (Rosyidah et al, 2021; Harun et al, 2024).

Learners exhibit a broad spectrum of misconceptions in integer operations. These include incorrect addition and subtraction of signed numbers, misapplication of rules in multiplication and division, and persistent errors in converting word problems into mathematical expressions. For example, in the addition of integers, students frequently ignore the rule of combining unlike signs. Typical errors include solving $3 + (-3)$ as 6 or $(-40) + 10$ as -50. Similarly, in subtraction, when asked to solve problems like “subtract 41 from –57,” students often reverse the operation or misinterpret the language, resulting in incorrect solutions like $41 - 57$ instead of $-57 - 41 = -98$. These errors are compounded when subtracting a larger number from a smaller one or converting verbal phrases into mathematical expressions Multiplication and division are no exception in these scenarios as students routinely forget sign rules, treating expressions such as $(-5) \times 6$ or $16 \times (-4)$ as positive values, or incorrectly handling operations involving like signs, such as solving $(-8) \times (-5)$ and arriving at -40 instead of 40. In division, students often provide correct numerical values but attach incorrect signs; such as, solving $45 \div (-9)$ as 5 instead of -5. Many of these errors stem from rule confusion, procedural gaps, or carelessness in dealing with negative signs (Harun et al, 2024).

More specifically, one of the most striking challenges observed was the misinterpretation of inequality symbols (‘<’ and ‘>’), which is fundamental to reasoning with integers. For instance, in a test involving sixty pre-service teachers, only 46.67% were able to correctly place the appropriate inequality symbol between two integers, such as –12 and 8, in a given sentence. Even more, concerning when asked to list suitable integers for expressions like $y < -5$ and $-10 < k$, error rates surged to 78.33% and 63.33% respectively. Many students wrongly listed positive numbers like {5, 6, 7…} for $y < -5$, clearly misunderstanding that the inequality requires values less than –5. Similarly, others selected values like {–11, –12, –13…} for $-10 < k$, when the correct response should have included numbers greater than –10. Interviews with these pre-service teachers revealed that some of these misconceptions stemmed from early teaching methods in basic school where arms were used to visually represent 'less than' and 'greater than' in a way that fostered mechanical understanding but not conceptual clarity (Toxtle-Colotl, Nieto-Ruiz & Juárez-López, 2025).

The above findings confirm that the misinterpretations of inequality symbols is not an isolated issue, but a reflection of deeper misconceptions about the structure and meaning of integer relationships. In reality, the inequality symbol '<' in an expression like $-12 < -8$ can be understood as either "–12 is less than –8" or "–8 is greater than –12," depending on the phrasing. Hence, its dual interpretations highlight the importance of understanding these symbols in relation to their mathematical context, rather than as fixed visual cues.

Misconceptions in additive inverse of integers; that is, error in changing the state of signs while transferring integers operations cannot be ruled out. For example, when presented with an equation like $-x + 4 = 7$, students commonly deviate by mismanaging the inverse operation required to isolate the variable, often solving for $x = 3$ instead of the correct $x = -3$. This type of error reflects a poor transfer of knowledge regarding inverse operations with positive and negative integers. Similarly, this error occurs in misinterpretation of inequality symbols while dealing with transfer of operation in situation like $-x > -3$ and $-x > 3$ which often finalized by students as $x > 3$ and $x > -3$ instead of the correct $x < 3$ and $x < -3$ respectively by reversing the inequality sign while managing the inverse operation required to isolate the variable

The Emphasis on Memorizations via Rote Learning by Traditional Methods of Teaching

Traditional methods of teaching integer operations often emphasize memorization of rules and procedural repetition without adequately fostering logical reasoning and conceptual clarity. This limits students' ability to generalize and apply their knowledge flexibly, especially when solving novel or context-based problems. Furthermore, with increasing diversity in classrooms and varied learner abilities, there is a need for more inclusive, structured, and visually engaging teaching strategies that accommodate all learners and support deeper understanding. Meanwhile, innovative strategies that leverage logical reasoning and structured patterns; such as truth tables and coding-based logic remain underutilized in mainstream mathematics instruction, despite their proven potential in enhancing learners' analytical thinking. These tools, commonly used in computer science and engineering education offer a systematic way to explore relationships between numbers and operations, and they provide a promising avenue for correcting misconceptions in integer operations.

Building on this foundation calls for an emerging need to explore logical reasoning tools; particularly truth tables and structured coding systems as pedagogical resources in teaching integer operations. Truth tables, commonly used in Boolean logic and computing, offer a structured and visual way to map out all possible outcomes of binary operations (Phalguni, Saniya, Akshay, Vinay & Pranavraj, 2023). When adapted to arithmetic contexts, such as comparing signed integers or solving conditional problems, they can help students visualize patterns, test mathematical conditions, and reinforce rule-based learning through logic.

Inclusive Mathematics Logic Instruction

The persistent difficulty students encountered in understanding and correctly applying integer operations and inequality concepts within the Nigerian Upper Basic Education curriculum is of concern. In light of these issues, the integration of truth tables and logic principles into Mathematics instruction offers a promising avenue for addressing these gaps. Raheem and Sam-Kayode (2024) submitted that, a truth table is a display of visual representation of all possible combinations of inputs and outputs for Boolean propositions in logical reasoning or Boolean functions in logic gates. In the referred submission, a provision was made for a structured means of organizing information, which allows learners to systematically evaluate the validity of statements made. This approach fosters analytical thinking, as it requires the application of Boolean algebra as a method of reasoning that promotes clear argumentation and logical proof. In the context of teaching, truth tables can be used to compare and contrast the connectives of logical reasoning and logic gates, making explicit the similarities, differences, and peculiarities in their interactive features.

The current paper therefore posited the application of truth tables and logical coding systems to support the teaching and learning of integer operations, including the additive inverse of positive and negative numbers, addition and subtraction of positive and negative numbers, multiplication and division of positive and negative numbers and interpretation of inequalities. Positioned within the scope of Nigeria's Upper Basic Education curriculum, this strategy aims to foster deeper conceptual understanding, promotes inclusivity, and address the persistent misconceptions learners face in working with integers and inequality relationships. For instance, in logic instruction, this method supports formal and informal reasoning through connectives such as negation (~), conjunction (∧), disjunction (∨), implication (⇒), bi-implication (⇔), equivalence (≡), helping learners validate arguments and interpret abstract relationships (Dvornichenko & Lysenko, 2022).

Logic Gates, Boolean Algebra and Truth Tables in Computer Science and Engineering Field

In computer science and engineering, logic gates and their respective connectives regarded as Bit Operator; such as: NOT ( ), AND (·), OR (+), NAND ($\overline{\cdot}$), NOR ($\overline{+}$), XOR (⊕) and XNOR ($\overline{\oplus}$) use Boolean algebra and truth tables to determine outputs based on binary inputs. These concepts bridge symbolic logic and visual representation, providing learners with a concrete method to understand abstract reasoning. The use of Boolean logic to represent mathematical ideas (1 for true, 0 for false) opens new avenues for conceptualizing mathematical operations through coding systems and visual logic charts (Dvornichenko & Lysenko, 2022).

Liu (2020)'s work on symbolic logic, propositions and their truth values can be treated similarly to set operations in terms of truth values; the universal set (U) of the set is treated as the truth value 1 (or T) of the true proportion, while the empty set (∅) of the set is viewed as the truth value 0 (or F) of the false proposition. While in terms of connectives, Negation (~) is treated as set complement (ð), Conjunction (∧) is treated as intersection operation (∩), Disjunction (∨) is treated as Union operation (∪), Implication (⇒) treated as proper subset (⊆), and Bi-implication (⇔) treated as equivalence (=). This mapping incorporates logic-based reasoning into mathematical learning in a way that is accessible, symbolic, and inclusive, and its principles can be applied to interpret errors in integer operations and design interventions that emphasize both correctness and logical structure.

As logical connectives determine outcomes in a truth table, integer operations can be mapped in a similar tabular form, showing the predictable results of combining positive and negative numbers. This process helps students to visualize operation rules rather than relying solely on memorization. For example, addition and subtraction of integers can be represented through binary-like conditions where positive and negative signs act as logical inputs truth values and the result serves as the output making the process more transparent.

Logic-based Teaching and Learning of Integers Operations

To address the gaps in students' mastery of integer operations and reduce misconceptions, this paper adopts a logic-based teaching strategy using truth tables to enhance learners' understanding as follows:

Table 1: Logical Coding of Integer Operations Truth Table Chart

Connectives		**Negation**		**Conjunction**	**Disjunction**	
Symbols			=	▯	▯	
Names		**Equal**		**Cap**	**Cup**	
Inputs		Outputs				
P	Q	P =	Q =	P ▯ Q	P ▯ Q	
+	+	−	−	+	+ (+)	+ (+)
+	−	−	+	−	+ (−)	− (−)
−	+	+	−	−	− (−)	+ (−)
−	−	+	+	+	− (+)	− (+)
					P > Q	P < Q

Source: Raheem, Adewale, Sam-Kayode & Adigun, 2025

NOTE: Input $\begin{Bmatrix} P = Positive/Negative\ Integers \\ Q = Positive/Negative\ Integers \end{Bmatrix}$ that is, $\forall\ p, q \in \mathbb{z}$

Output $\begin{Bmatrix} + = Plus\ (purse) \\ - = Minus\ (debt) \end{Bmatrix}$ that is, Truth values

Table 2: Application of Logical Coding of Integer Operations Truth Table Chart

Connectives		**Negation**		**Conjunction**	**Disjunction**	
Symbols		=		∩	∪	
Names		**Equal**		**Cap**	**Cup**	
Inputs		Outputs				
P	Q	P =	Q =	P ∩ Q	P ∪ Q	
+ (P)	+ (Q)	− (P)	− (Q)	+ (PQ)	+ (P + Q)	+ (P + Q)
+ (P)	− (Q)	− (P)	+ (Q)	− (PQ)	+ (P − Q)	− (P − Q)
− (P)	+ (Q)	+ (P)	− (Q)	− (PQ)	− (P − Q)	+ (P − Q)
− (P)	− (Q)	+ (P)	+ (Q)	+ (PQ)	− (P + Q)	− (P + Q)
					P > Q	P < Q

Source: Raheem, Adewale, Sam-Kayode & Adigun, 2025

For all inputs (P and Q) are members of integer ($\forall\ p, q \in \mathbb{Z}$) from table 1 and table 2. Thus, logic-based teaching and learning of integers operations can be done through the following truth tables templates provided below by asking students to provide integers for inputs (P and Q) and provide appropriate outputs based on the rules of each connective adopted in this paper. Teacher serve as moderator to guide students through the process of assigning integers for the inputs (P and Q). The following are the interpretation of each connective:

1. **Negation (=):** uses equal (=) as connective and serve as addictive inverse of positive and negative integers with single input. Just like conjugation of sign; addictive inverse changes the state of positive integer to negative integer of the same value and vice versa$\left\{\begin{matrix} P & P = \\ + & - \\ - & + \end{matrix}\right\}$. Thus, negation of integer is limited to addition and subtraction of integer operations while transferring positive or negative integers. This means, there exist no change of positive or negative integer sign while cross multiplying or dividing both side by coefficient. For example, transferring of operations to isolate x in the following simple equations: $x \underline{-2} = 4$ result to $x = 4 \underline{+2}$; and $x \underline{+2} = 4$ result to $x = 4 \underline{-2}$; while $^{x}/_{-2} = 4$ (by cross multiply) result to $x = 4(-2)$; and $-2x = 4$ (by divide both sides by coefficient of x, that is -2) result to $x = {}^{4}/_{-2}$.

Table 3: Additive Inverse of Positive and Negative Numbers Truth Table

Connectives		**Negation**	
Symbols			=
Names		**Equal**	
Inputs		Outputs	
P	Q	P =	Q =
+ ( )	+ ( )	− ( )	− ( )
+ ( )	− ( )	− ( )	+ ( )
− ( )	+ ( )	+ ( )	− ( )
− ( )	− ( )	+ ( )	+ ( )

Source: Raheem, Adewale, Sam-Kayode & Adigun, 2025

Note: Since zero comprises no positive or negative sign as coefficient, zero has no additive inverse. Similarly, in inequality, there exist additive inverse while transferring positive or negative integers without reversing the state of inequality symbol. For example, transferring of operations to find the value of x in the following inequalities: $x \underline{-2} > 4$ result to $x > 4 \underline{+2}$; and $x \underline{+2} < 4$ result to $x < 4 \underline{-2}$. Inversely, when multiplying or dividing unknown value in inequality by a negative number, the inequality symbol must be reversed. For example, to isolate x in the following inequalities: $-x > -2$ and $-x > 2$ (by multiply or divide by -1 and reverse the inequality symbol) result to $x < 2$ and $x < -2$ respectively.

Note: Since zero is a neutral number that set boundary of magnitude for positive and negative numbers; zero is significant in reversing inequality symbols as additive inverse to isolate x in the following inequalities: $-x > 0$ and $-x < 0$ (by multiply or divide by -1 and reverse the inequality symbol) result to $x < 0$ and $x > 0$ respectively.

2. **Conjunction (▯):** uses cap (▯) as connective and since multiplication and division of integer sign are determined in the same manner. For example: $(+4) \times (-2) = -8$ and $^{+4}/_{-2} = -2$; though, their results are different but comprise the same negative integer sign. Thus, this connective serves as multiplication and division of positive and negative integers sign with two inputs that result to positive integers when there exist same integers sign as inputs truth

values$\left\{\begin{matrix} P & Q & P & Q \\ + & + & & + \\ - & - & & + \end{matrix}\right\}$. Otherwise, the results are negative integers when there exist different integers sign as inputs truth values$\left\{\begin{matrix} P & Q & P & Q \\ + & - & & - \\ - & + & & - \end{matrix}\right\}$.

Table 4: Multiplication and Division of Positive and Negative Numbers Truth Table

Connectives		**Conjunction**
Symbols		**∩**
Names		**Cap**
Inputs		Outputs
P	Q	P ∩ Q
+ ( )	+ ( )	+ ( )
+ ( )	− ( )	− ( )
− ( )	+ ( )	− ( )
− ( )	− ( )	+ ( )

Source: Raheem, Adewale, Sam-Kayode & Adigun, 2025

Note: Any integers multiplied or divided by zero neutralizes to zero as an output.

3. **Disjunction (∪):** uses cup (∪) as connective and serve as addition or subtraction of positive and negative integers with two inputs that their output integers sign is determined by conditional statement. That is, if input P > Q; then, the connective results to input P truth values as corresponding coefficient integer sign and execute addition when there exist same integers sign as inputs truth values, while execute subtraction when there exist different integers sign as inputs truth values. Inversely, if input P < Q; then, the connective results to input Q truth values as corresponding coefficient integer sign and execute addition when there exist same integers sign as inputs truth values, while execute subtraction when there exist different integers sign as inputs truth values. Thus, either input P > Q or P < Q; addition will be executed when there exist same integers sign as inputs truth values$\left\{\begin{matrix} P & Q & P & Q \\ + & + & & + \\ - & - & & + \end{matrix}\right\}$. While subtraction

will be executed when there exist different integers sign as inputs truth values $\begin{Bmatrix} P & Q & P & Q \\ + & - & & - \\ - & + & & - \end{Bmatrix}$.

Therefore, disjunction connective cup (∪) result is similar to conjunction connective cap (∩) result; the only different is the output integer sign as coefficient of the result that is determined by conditional statement in disjunction and multiplication of integer sign in conjunction.

Note: Avoid assigning integers of equal number regardless of being positive or negative for inputs (P and Q) in Table 5, if there exist equal integer with different integers sign, the output will be zero $\begin{Bmatrix} P & Q & P & Q \\ +(P) & -(Q) & 0 & \\ -(P) & +(Q) & 0 & \end{Bmatrix}$. Furthermore, any positive or negative integer added to or subtracted from zero; such integer repeats itself as an output.

Teaching concept of integer through the number line model in figure 1 below; interpretation of inequalities can be taught in logical coding of integers operations as follows:

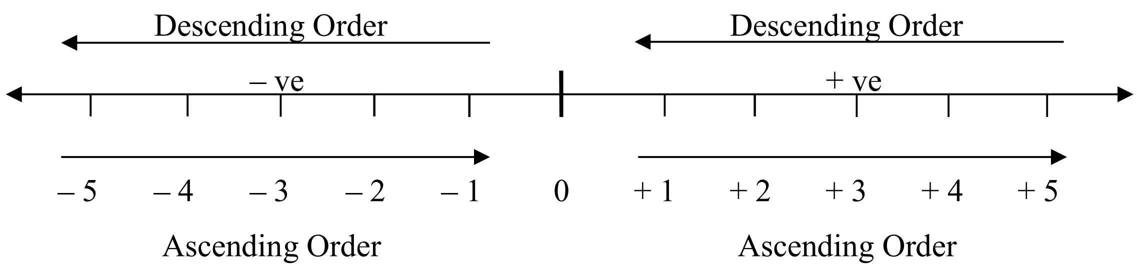

Figure 1: Number Line Model

Source: Raheem, Adewale, Sam-Kayode & Adigun, 2025

Ascending order: Refers to arrangement of integers from smallest to largest. Using figure 1 above for example; from – 5(the smallest) to – 1(the largest) is the ascending order on negative part of the number line which means – 5 is less than – 1; that is, the higher the number, the lower the value in negative magnitude. While, from + 1(the smallest) to + 5(the largest) is the ascending order on positive part of the number line which means + 1 is less than + 5; that is, the higher the number, the higher the value in positive magnitude.

Descending order: Refers to arrangement of integers from largest to smallest. Using figure 1for example; from – 1(the largest) to – 5(the smallest) is the descending order on negative part of the number line which means – 1 is greater than – 5; that is, the lower the number, the higher the value in negative magnitude. While, from + 5(the largest) to + 1(the smallest) is the descending order on positive part of the number line which means + 5 is greater than + 1; that is, the lower the number, the lower the value in positive magnitude.

The ascending and descending order on positive and negative part of the number line can result to a proven law based on figure 1above; the first law is titled: Magnitude law of negative integers which state that, the higher the number, the lower the value in negative magnitude and vice versa. This newly established law is in line with the law of demand which also state that the higher the price, the lower the quantity demanded and vice versa. The second law is titled: Magnitude law of positive integers which state that, the higher the number, the higher the value in positive magnitude and vice versa. Similarly, this newly established law is in line with the law of supply which also state that the higher the price, the higher the quantity supplied and vice versa. The third law is titled: Magnitude law of positive and negative integers which state that all positive numbers are greater than all negative numbers regardless of their values and vice versa. While the fourth law is titled: Magnitude law of zero, positive and negative integers which state that while all negative numbers are less than zero, all positive numbers are greater than zero and vice versa. The ideas from the stated four magnitude laws of integers can be adopted as introduction to teaching and learning interpretation of inequality using logic-based teaching strategy through the truth table as follows:

Table 6: Interpretation of Inequalities Truth Table

Connectives		**Disjunction**	
Symbols		**$\cup$**	
Names		**Cup**	
Inputs		Outputs	
P	Q	$P \cup Q$	
+ ( )	+ ( )	( )	( )
+ ( )	− ( )	( )	( )
− ( )	+ ( )	( )	( )
− ( )	− ( )	( )	( )
		$P > Q$	$P < Q$

Source: Raheem, Adewale, Sam-Kayode & Adigun, 2025

Note: True (T) and False (F) can be used to determine the output of P > Q and P < Q in Table 6.

Logical Coding of Integer Operations

In logical coding of integers operations; adopted connectives are Negation (=), Conjunction (∧) and Disjunction (∨). The interpretation of the connectives explicitly defines the operational terms involved in this paper. Such as, integer operations (+, –, ×, ÷), inequality symbols ('<' and '>') and integer signs (plus '+' and minus '–'). Integer operations refer to the function of connectives adopted in this paper as coding system. Inequality symbols refer to the conditional statement signs used in this paper to interpret inequalities and determine the positive or negative coefficient of integer result in disjunction (∨). Integer signs refer to the truth values used in the truth table adopted for logical coding of integer operation in this paper.

Connectives operations: In logical coding of integers operations; Negation (=) act in the same manner as Negation (~), NOT ( ) and Set Complement (ð) in logical reasoning, logic gate and set symbolic logic respectively. While Conjunction (∧) act in the same manner as Conjunction (∧), AND (·) and Intersection Operation (∩) in logical reasoning, logic gate and set symbolic logic respectively and Disjunction (∨) act in the same manner as Disjunction (∨), OR (+) and Union Operation (∪) in logical reasoning, logic gate and set symbolic logic respectively. Thus, Conjunction (∧) and Disjunction (∨) in logical coding of integers operations are similar in names, symbols and operations with Conjunction (∧) and Disjunction (∨) in logical reasoning. Apart from symbols; Negation (=) in logical coding of integers operations is only similar in name and operation with Negation (~) in logical reasoning. While Negation (=), Conjunction (∧) and Disjunction (∨) in logical coding of integers operations are only similar in operations with other connectives in logic gate (NOT ( ), AND (·) and OR (+) respectively) and set symbolic logic (Set Complement (ð), Intersection Operation (∩) and Union Operation (∪) respectively). Unlike other symbolic logic connectives operations, each connective in logical coding of integers operation serves two operations at a time (Liu, 2020; Dvornichenko & Lysenko, 2022; Raheem & Sam-Kayode 2024).

Truth value types: In logical coding of integers operations; the truth value plus (+) is treated as True (T), High (1), Universal Set (U) and Open (II) in logical reasoning, logic gate, set symbolic logic and Ifá coding system respectively. While the truth value minus (–) is treated as False (F), Low (0), Empty Set (∅) and Close (I) in logical reasoning, logic gate, set symbolic logic and Ifá coding system respectively. Thus, truth values in logical coding of integers operations are treated similarly to discrete value used as truth values in other symbolic logic but different in symbols, names and output. While other symbolic logic maintained one out of the two truth values as single output at a time, logical coding of integers operations presents the two truth values at a time as output in disjunction (∨). Though, one serves as coefficient sign while the other serve as operation (Liu, 2020; Dvornichenko & Lysenko, 2022; Raheem & Sam-Kayode 2024; Raheem, Sam-Kayode & Adigun, 2024).

Conclusion

It is concluded that the use of truth tables and coding-based logic concepts in teaching integer operations presents a dual benefit: it bridges the gap between abstract logical reasoning and concrete mathematical application, and it provides an inclusive strategy (logic-based teaching strategy) that reduces reliance on rote memorization. By making explicit, the patterns, consistencies, and rule-based nature of integer operations, this method enhances critical thinking and equip learners with transferable skills that extend beyond mathematics into disciplines such as computer science and engineering.

Suggestions

Based on logical reasoning and structured patterns / features of logic-based teaching strategy provided as inclusive strategy to bridge the stated gaps in this paper; application of truth tables and logical coding systems should be promoted and considered to support the teaching and learning of integer operations, including the additive inverse of positive and negative numbers, addition and subtraction of positive and negative numbers, multiplication and division of positive and negative numbers and interpretation of inequalities against persistent difficulties and misconceptions that hinder students conceptual understanding and problem-solving abilities in integer operations.

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