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Exploring a Slow Learner's Use of The Standard Multiplication Algorithm

Averylla Dwi Endri Prastiya[1], Nia Wahyu Damayanti[2]

[1]Universitas Negeri Surabaya, Surabaya, Indonesia, averylla.23047@mhs.unesa.ac.id
[2]Universitas Negeri Surabaya, Surabaya, Indonesia, niadamayanti@unesa.ac.id

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ABSTRACT

The standard multiplication algorithm requires the coordinated use of place value, multiplication facts, regrouping, and accurate recording of results. This study examined how these components were applied within a single case involving a learner identified as a slow learner when solving two-digit-by-one-digit multiplication problems. A qualitative descriptive single-case design involved one purposively selected student identified as a slow learner at an inclusive public junior high school in Surabaya. Instruments comprised a 15-item multiplication worksheet and a semi-structured interview guide. Data were collected through individual worksheet completion and an interview immediately afterward. Analysis followed data condensation, data display, and conclusion drawing and verification across five aspects: place-value identification, place-value-based multiplication, regrouping, recording of results, and final-answer accuracy. Initial written work and interview explanations were compared item by item to identify cross-item patterns. The results showed consistent application of the algorithm on 11 problems. Four problems displayed discrepancies between the initial work and the procedures stated or reconstructed during the interview. The findings indicate that place-value alignment and most regrouping steps were relatively stable, whereas operation selection and the recording of results remained inconsistent. Instruction should therefore target the unstable components through explicit comparison of multiplication and addition, multiplication-fact practice, expanded notation, and partial products rather than reteaching the entire algorithm.

Corresponding Author:
Averylla Dwi Endri Prastiya
Universitas Negeri Surabaya, Surabaya, Indonesia; averylla.23047@mhs.unesa.ac.id

INTRODUCTION

Multiplication is a fundamental whole-number operation introduced in elementary school. More broadly, multiplicative thinking supports learning about fractions, proportions, measurement, and algebraic thinking (Malola & Seah, 2024). Mastery of multiplication involves not only memorizing multiplication facts but also developing conceptual understanding, procedural fluency, the use of representations, and an understanding of why a procedure works (Novikasari & Dede, 2024; Putra et al., 2023; Zakaria & Dewantara, 2024). In multidigit computations, place-value understanding is essential because the value of a digit is determined by its position within the base-ten number system (Jenal Mutaqin et al., 2023; Jensen et al., 2024; Mix et al., 2022). Therefore, students' use of the multiplication algorithm needs to be analyzed at the level of its procedural components rather than assessed solely on the basis of the accuracy of the final answer.

Conceptual knowledge concerns understanding mathematical ideas and relationships, whereas procedural knowledge concerns knowing how to carry out mathematical procedures. A review by Rittle-Johnson et al. (2015) indicates that these forms of knowledge can support each other's development, rather than developing only in a fixed sequence from concepts to procedures. In multiplication, this distinction draws attention to both the execution of calculation steps and the learner's understanding of the place-value relationships underlying those steps. The final answer alone does not show how the learner selected an operation, interpreted a regrouped digit, or decided where to record the result. Examining written work alongside interview explanations therefore allows the analysis to consider both the steps recorded and the reasons the learner gives for them, while identifying any discrepancies between these two sources of evidence.

The standard multiplication algorithm is a compact form of place-value-based multiplication. Van de Walle et al. (2016) explain that the algorithm should be developed through concrete or semi-concrete models and the recording of partial products before students move to a more compact written form. For two-digit-by-one-digit multiplication, use of the compact form involves aligning the multiplier with the ones digit, multiplying the ones and tens digits according to their place values, regrouping when the product obtained by multiplying the ones digits is a two-digit number, and recording each digit of the product in its appropriate place-value position (Van de Walle et al., 2016). Thus, a correct final answer does not necessarily demonstrate that all these components have been applied accurately and consistently.

Coordinating these procedural components raises a question about how learners who need additional instructional support apply the algorithm. Some students identified as slow learners may require more time to process symbols, abstract concepts, and multi-step instructions (Listiawati et al., 2023; Wafiroh & Harun, 2022). In arithmetic, working memory is involved when students recall arithmetic facts, retain intermediate results, and coordinate sequential stages of calculation (Zhang et al., 2023). However, these general characteristics cannot automatically be used to explain an individual student's errors because the abilities and learning needs of students identified as slow learners are heterogeneous. (Jannah et al., 2025), for example, found differences in abilities and support needs between two students identified as slow learners when learning number operations. These differences underscore the need for an individualized analysis that examines how a student applies a procedure across several items, rather than drawing conclusions solely from a learner label or a single response.

Previous research on mathematics education for students identified as slow learners has largely examined instructional support through realistic contexts, scaffolding, manipulatives, differentiated instruction, and educational games (Firmansyah et al., 2025; Hafidah & Rukli, 2022; Jannah et al., 2025; Listiawati et al., 2023; Wibawa et al, 2026). Other research has identified difficulties with integer operations and designed scaffolding tailored to the participant's needs (Susilo et al., 2022). Meanwhile, the systematic review by Wanabuliandari et al. (2025) specifically mapped factors and strategies associated with mathematical problem solving among students identified as slow learners. Collectively, these studies provide important insights into students' difficulties and forms of instructional support, but their primary focus is on interventions, problem solving, or broad mathematical competencies.

The motivation for this study is the need to identify which components of a learner’s multiplication procedure require support, since final-answer accuracy alone provides insufficient guidance for individualized instruction. In the literature reviewed for this study, few detailed accounts were found of how an individual student identified as a slow learner applies each component of the standard multiplication algorithm across a set of two-digit-by-one-digit problems. The review by Lin et al. (2025) indicates that error analysis can be used to identify error patterns among students with mathematics difficulties across various topics. However, classifying responses merely as correct or incorrect does not reveal which procedural components were used on each item (Fauziah & Pandra, 2024). Interviews can supplement written work by providing information about how students understand or explain a solution step (Elvierayani et al., 2025; Lewis & Fisher, 2018; Setiyani et al., 2024). Comparing initial written work with subsequent interview explanations also makes it possible to distinguish procedures applied independently from those articulated or reconstructed only after prompting questions.

To address this gap, the present study examines how one student identified as a slow learner applies the standard multiplication algorithm to 15 two-digit-by-one-digit multiplication problems, including problems both with and without regrouping. The analysis is based on five aspects: four procedural components (identifying the place value of each digit, multiplying according to place value, regrouping, and recording the product) and one outcome indicator (the accuracy of the final answer). Each aspect is analyzed at the item level by comparing the participant's initial written work with the participant's explanations during the interview. The analytic status assigned to each aspect for each item is used to trace patterns of consistency and inconsistency across items, rather than to attribute fixed traits to the participant.

The research question guiding this study is as follows: How does a student identified as a slow learner apply the standard multiplication algorithm when solving two-digit-by-one-digit multiplication problems? Accordingly, this study aims to describe how the participant identifies the place value of each digit, multiplies according to place value, regroups when necessary, records each digit of the result in its appropriate place-value position, and determines the final answer. This description is expected to provide an empirical basis for designing individualized instructional support that takes into account both the components applied consistently and those whose application remains inconsistent. The conclusions remain limited to the single case and task set examined.

METHOD

This study employed a qualitative approach with a descriptive single-case study design. This design was selected to provide an in-depth account of how a student identified as a slow learner applied the standard multiplication algorithm when solving two-digit-by-one-digit multiplication problems. The case was bounded by one participant, one mathematical topic, one task set comprising 15 items, and two primary data sources: the participant's written work on the worksheet and the interview transcript. The findings were intended to provide a contextual understanding of the case and not to support statistical generalization to all students identified as slow learners (Creswell, 2012).

The study was conducted at a public junior high school providing inclusive education in Surabaya during the second semester of the 2025/2026 academic year. The participant was one student identified as a slow learner, assigned the code S, and selected through purposive sampling. The selection criteria were as follows: identification as a slow learner based on school records and the results of a psychological assessment; prior instruction in multiplication; ability to participate in the task and interview; and school permission, written consent from a parent or guardian, and the participant's assent to participate. Purposive sampling was used because the participant could provide information relevant to the phenomenon under investigation (Creswell, 2012).

The researcher served as the primary research instrument, while the supporting instruments comprised a multiplication worksheet and a semi-structured interview guide. The worksheet contained 15 two-digit-by-one-digit multiplication items. Eight items required regrouping because the product obtained by multiplying the ones digits was a two-digit number, whereas the other seven did not require regrouping. Both categories were included so that the participant's application of the procedure could be observed both when regrouping was and was not required. The worksheet was used to elicit procedural evidence, not to generate a standardized test score. The items are listed in Table 1.

Table 1. List of Multiplication Items

Item number	Problem	Category
1	11 × 4	No regrouping
2	12 × 2	No regrouping
3	13 × 3	No regrouping
4	14 × 2	No regrouping
5	15 × 4	Regrouping required
6	16 × 2	Regrouping required
7	17 × 5	Regrouping required
8	18 × 2	Regrouping required
9	19 × 3	Regrouping required
10	20 × 4	No regrouping
11	21 × 1	No regrouping
12	22 × 2	No regrouping
13	23 × 4	Regrouping required
14	24 × 3	Regrouping required
15	25 × 5	Regrouping required

The interview guide included questions about place value, the sequence of multiplication steps, the origin of the digits recorded, the regrouping process, and the final answer. Table 2 presents the five analytical aspects developed by drawing on Van de Walle et al. (2016) account of the standard multiplication algorithm, place value, the recording of results, and regrouping.

Table 2. Indicators for Analyzing the Application of the Standard Multiplication Algorithm

Aspect	Indicator	Code
Place value	Identifies the place value of each digit in the multiplicand.	NT
Place-value-based multiplication	Multiplies according to place value (ones, tens, hundreds, and so forth).	PN
Regrouping	If multiplying the ones digits produces a two-digit number, the tens digit is regrouped correctly into the next place-value position.	RG
Recording multiplication results	Records the result of each multiplication step in its appropriate place-value position.	PH
Accuracy of the final answer	Determines and records the correct final product.	KH

Source: Adapted from Van de Walle et al. (2016).

Data collection proceeded in three stages. First, the researcher obtained permission and confirmed that the participant met the selection criteria. Second, the participant completed the 15 worksheet items individually and without a strict time limit. The researcher provided no solution cues, corrections, or confirmation of whether responses were correct during task completion; therefore, the written work represented the participant's initial performance. Third, immediately after the task session, the researcher showed the participant the relevant written responses and conducted an interview to clarify the steps, reasoning, and origin of the digits in each response. The interview was recorded and transcribed. Responses elicited after probing questions were marked separately; corrections or reconstructions during the interview did not alter the initial written responses. The video recording of the task-completion process was retained for documentation and was not coded as a data source.

The unit of analysis was one item together with the participant's initial written work and the interview segment addressing that item. The analysis followed three interrelated streams of activity: data condensation, data display, and conclusion drawing and verification (Miles et al., 2014). During data condensation, the initial written work was reviewed, the interview was transcribed, verbal segments were matched to item numbers, and the evidence was coded according to NT, PN, RG, PH, and KH. The data were organized in a working matrix comprising 15 items and 5 indicators, presented descriptively by item, and condensed into recurring patterns. An analytic status was assigned to each indicator for each item according to the operational rules in Table 3; the statuses were used to organize the evidence rather than to assign scores or characterize fixed attributes of the participant.

Table 3. Operational Rules for Assigning Analytic Status

Status	Operational rule
Met	The indicator is applied correctly in the initial written work and/or the participant's explanation, with no contradictory evidence for the same segment.
Not met	The step used for the item does not satisfy the indicator, and no other direct evidence demonstrates correct application in the segment being assessed.
Inconsistent evidence	The initial written work and interview explanation provide different evidence; this status does not indicate that the initial response should be regarded as correct.
Undetermined	The written and interview evidence is insufficient to make a defensible determination about the application of the indicator.
Not required	For RG only: the product of the ones digits is a single digit, so no tens digit needs to be regrouped.
Correct/Incorrect	Used only for KH by comparing the initial written answer with the correct product.

The statuses Met, Not met, Inconsistent evidence, and Undetermined were used for NT, PN, RG, and PH; Not required was used only for RG; and Correct/Incorrect was used only for KH. Each status assignment was based on direct evidence relevant to the indicator. Spontaneous responses were distinguished from responses elicited after probing questions; a procedure reconstructed only during the interview did not replace the initial written work. For items not discussed during the interview, assessment was limited to the written evidence; when that evidence was insufficient, the Undetermined status was assigned. Conclusions were drawn from patterns across items and verified against the worksheet, interview transcript, and analysis matrix.

RESULTS

The results were obtained by comparing the participant's initial written work with the participant's interview explanations for 15 two-digit-by-one-digit multiplication items. Each item was analyzed in terms of place value (NT), place-value-based multiplication (PN), regrouping (RG), recording multiplication results (PH), and accuracy of the final answer (KH). An analytic status was assigned to each indicator for each item based on evidence from both data sources and was not intended to represent a fixed attribute of the participant. Of the 15 initial responses, 11 had correct final answers, whereas four had incorrect final answers: Items 3, 9, 10, and 11. Table 1 groups the items according to their combinations of indicator statuses.

Table 4. Analytic Status Patterns for the Application of the Standard Multiplication Algorithm Across 15 Items

Item (problem)	NT	PN	RG	PH	KH
1 (11 × 4), 2 (12 × 2), 4 (14 × 2), and 12 (22 × 2)	Met	Met	Not required	Met	Correct
5 (15 × 4), 6 (16 × 2), 7 (17 × 5), 8 (18 × 2), 13 (23 × 4), 14 (24 × 3), and 15 (25 × 5)	Met	Met	Met	Met	Correct
3 (13 × 3)	Undetermined	Inconsistent evidence	Not required	Not met	Incorrect
9 (19 × 3)	Met	Inconsistent evidence	Inconsistent evidence	Inconsistent evidence	Incorrect
10 (20 × 4) and 11 (21 × 1)	Met	Inconsistent evidence	Not required	Not met	Incorrect

Based on Table 1, NT was categorized as Met on 14 items and as Undetermined on one item. PN was categorized as Met on 11 items, while four items showed Inconsistent evidence.

RG was required on eight items; it was categorized as Met on seven of them, while one showed Inconsistent evidence. For PH, 11 items were categorized as Met, three as Not met, and one as Inconsistent evidence. The KH status was Correct for 11 items and Incorrect for four items.

Application of the Indicators to Items with Correct Final Answers

On eleven items (Items 1, 2, 4, 5, 6, 7, 8, 12, 13, 14, and 15), the participant's written work and interview explanations provided consistent evidence of indicator application. These items formed two patterns: items that did not require RG and items that required RG.

On Items 1, 2, 4, and 12, which did not require RG, multiplying the ones digits produced a single-digit result; therefore, there was no tens digit to regroup. Item 4 (14 × 2) is presented as a representative example of this pattern.

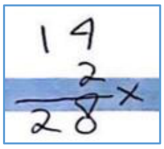

Figure 1. Participant's Written Work on Item 4 (14 × 2)

As shown in Figure 1, the participant set up 14 × 2 vertically, aligned the multiplier 2 in the ones position, and obtained the correct final answer of 28. This arrangement provided initial evidence that the digits in the multiplicand were positioned according to place value. To clarify the participant's understanding of the arrangement and multiplication sequence, the researcher explored these points in the following interview.

PS-1 : *"In the number 14, what place value does the 4 have?"*
JS-1 : *"Ones, ma'am."*
PS-2 : *"What place value does the 1 have in the number 14?"*
JS-2 : *"Tens."*
PS-3 : *"And in the number 2, what place value does the 2 have?"*
JS-3 : *"Ones."*
PS-4 : *"Then how do you set them up?"*
JS-4 : *"This 2 is in the ones place, so I put it under the 4, ma'am."* ***(NT)***
PS-5 : *"Tell me which part you multiplied first."*
JS-5 : *"First I multiplied 2 × 4, ma'am, and then 2 × 1."* ***(PN)***

The interview explanations strengthened the evidence from the written work. For NT, the participant identified 4 in 14 as the ones digit, 1 as the tens digit, and the multiplier 2 as a ones digit. The participant also explained that 2 was placed beneath 4 because both occupied the ones position. For PN, the participant explained that 2 × 4 was performed first, followed by 2 × 1. Because 2 × 4 = 8 is a single-digit product, RG was not required. Thus, on Item 4, NT, PN, and PH were categorized as Met, RG as Not required, and KH as Correct.

On the other seven items (Items 5, 6, 7, 8, 13, 14, and 15), multiplying the ones digits produced a two-digit result and therefore required RG. On these items, the participant recorded the ones digit of the first product in the ones position and regrouped the tens digit into the tens position. Item 5 (15 × 4) is presented as a representative example of this pattern.

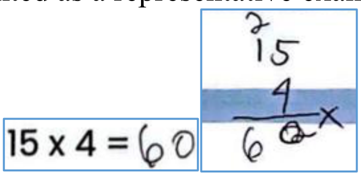

Figure 2. Participant's Written Work on Item 5 (15 × 4)

Figure 2 shows that the participant obtained 4 × 5 = 20, recorded 0 in the ones position, and placed 2 in the tens position through regrouping. The participant then continued by multiplying the tens digit and obtained the correct final answer of 60. The steps evident in the written work were subsequently confirmed in the following interview.

PS-6 : *"Tell me which part you multiplied first and how you wrote the result."*

JS-6 : *"First I multiplied 4 × 5, ma'am. The result was 20, so I wrote the 0 and carried the 2 above the 1 (meaning that the 2 was placed in the tens position)."* ***(RG)***

PS-7 : *"What did you do next?"*

JS-7 : *"Then 4 × 1 was 4, and I added the 2 that I carried above the 1."*

The interview explanation was consistent with the participant's written work. For RG, the participant explained that, from the product 20, 0 was written in the ones position and 2 was carried to the tens position. The participant then calculated 4 × 1 = 4 and added the regrouped 2, producing 6 in the tens position. Thus, on Item 5, NT, PN, RG, and PH were categorized as Met, and KH as Correct.

Discrepancies Between Initial Written Work and Interview Explanations

In contrast to the preceding eleven items, Items 3, 9, 10, and 11 showed discrepancies between the participant's initial written work and interview explanations. These discrepancies were not used to reclassify the initial responses as correct; rather, they indicated differences between the procedure evident in the written work and the procedure that the participant could explain or reconstruct during the interview.

Item 3 (13 × 3)

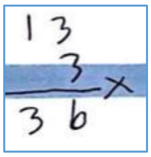

Figure 3. Participant's Written Work on Item 3 (13 × 3)

In Figure 3, the participant recorded a final answer of 36, whereas the correct product is 39. The digit 6 was written in the ones position. To investigate the source of this digit and the multiplication procedure used, the researcher asked the following questions.

PS-8 : *"Tell me which part you multiplied first and then the next part."*

JS-8 : *"First I multiplied 3 × 3, ma'am, and then 3 × 1."*

PS-9 : *"What is 3 × 3?"*

JS-9 : *"9, ma'am."*

PS-10 : *"On your answer sheet, you wrote 6 in the ones place. Where did the 6 come from?"*

JS-10 : *"Yes, ma'am. I used addition instead."*

The participant's interview explanation differed from the initial written work. During the interview, the participant stated that the calculation began with 3 × 3 and correctly gave the result as 9. However, the written work showed 6 in the ones position, which the participant attributed to using addition. Accordingly, PN was categorized as Inconsistent evidence, PH as Not met, and KH as Incorrect. NT was categorized as Undetermined because this item provided no direct evidence that the participant had identified the place value of each digit.

Item 10 (20 × 4)

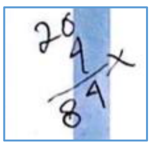

Figure 4. Participant's Written Work on Item 10 (20 × 4)

Figure 4 shows that the participant recorded a final answer of 84. The digit 4 was placed in the ones position, although $4 \times 0 = 0$. This discrepancy was explored in the following interview.

PS-11 : *"What is 4 × 0?"*

JS-11 : *"0, ma'am."*

PS-12 : *"How do you know the result is 0?"*

JS-12 : *"Anything multiplied by 0 is 0, ma'am."*

PS-13 : *"On your answer sheet, you wrote 4 in the ones place. Where did the 4 come from?"*

JS-13 : *"I added them, ma'am. I forgot it was multiplication."*

During the interview, the participant stated that $4 \times 0 = 0$ and explained that any number multiplied by 0 equals 0. However, the initial written work showed a final answer of 84. The participant then explained that the 4 in the ones position resulted from using addition. Thus, PN was categorized as Inconsistent evidence, PH as Not met, and KH as Incorrect, whereas NT was categorized as Met based on the place-value arrangement in the written work.

Item 11 (21 × 1)

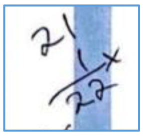

Figure 5. Participant's Written Work on Item 11 (21 × 1)

In Figure 5, the participant recorded a final answer of 22. To investigate the process that produced 2 in the ones position, the researcher conducted the following interview.

PS-14 : *"What is 1 × 1?"*

JS-14 : *"2."*

PS-15 : *"Try calculating it again. What is 1 × 1?"*

JS-15 : *"Oh, 1, ma'am."*

PS-16 : *"On your answer sheet, you wrote 2 in the ones place. Where did the 2 come from?"*

JS-16 : *"I added them, ma'am."*

The participant initially answered that $1 \times 1 = 2$, then corrected the answer to 1 after being asked to recalculate. Nevertheless, the initial written work still showed a final answer of 22. The statement "I added them, ma'am" indicated that the 2 in the ones position came from addition rather than 1×1. Accordingly, PN was categorized as Inconsistent evidence, PH as Not met, and KH as Incorrect, whereas NT was categorized as Met based on the place-value arrangement in the written work.

Inconsistency in Regrouping on Item 9

Item 9 (19 × 3) differed from the preceding three items because the inconsistency concerned not only multiplication facts but also regrouping. It was the only item requiring RG for which the initial written work did not show consistent application of RG.

Figure 6. Participant's Written Work on Item 9 (19 × 3)

As shown in Figure 6, the participant recorded a final answer of 72 rather than 57. To investigate the procedure used, the researcher conducted the following interview.

PS-17 : *"What is 3 × 9?"*

JS-17 : *[silent]*

PS-18	:	*"What is 9 + 9?"*
JS-18	:	*"18."*
PS-19	:	*"What is 18 + 9?"*
JS-19	:	*"27."*
PS-20	:	*"On your answer sheet, you wrote 72. Can you explain how you got that result?"*
JS-20	:	*"That was wrong, ma'am. I reversed it. I should have written the 7 and carried the 2 above the next digit, right, ma'am?"*

When asked to determine 3 × 9, the participant did not initially provide an answer. After the researcher elicited the product through 9 + 9 and 18 + 9, the participant obtained 27. When subsequently asked to explain the 72 in the written work, the participant stated that the digits had been reversed. The participant then reconstructed the procedure, explaining that 7 should have been written and 2 carried to the next position.

This reconstruction differed from the initial written work and was therefore not used to reclassify the initial response as correct. Accordingly, PN, RG, and PH on Item 9 were categorized as Inconsistent evidence, while KH remained Incorrect.

Overall Pattern in the Application of the Standard Multiplication Algorithm

Overall, the task set revealed two main patterns. First, on 11 items, the written work and interview explanations provided consistent evidence concerning place value, the sequence of place-value-based multiplication, RG when required, the recording of results, and the accuracy of the final answer. Second, on Items 3, 9, 10, and 11, discrepancies were found between the initial written work and multiplication procedures or facts that the participant could state or reconstruct during the interview. On Items 3, 10, and 11, the discrepancies primarily involved the use of addition in the initial work; on Item 9, the discrepancy involved reversing the digits of the product 27 during RG. Procedures that emerged only after probing questions were kept distinct from the application evident in the initial written work.

DISCUSSION

The findings show that the participant's application of the standard multiplication algorithm cannot be adequately understood through a simple dichotomy of ability versus inability. On 11 of the 15 items, evidence from the written work and interview explanations consistently showed that the participant applied place-value principles, followed the multiplication sequence, recorded results according to place value, and performed regrouping when required. On the other four items, however, discrepancies arose involving the use of addition at particular steps and the reversal of the digit order in a multiplication result. This pattern indicates that the participant had a procedure that could be used independently on most items, but control over operation selection and the recording of results was not stable across all situations. This cross-item pattern interpretation is consistent with the view that error analysis should distinguish isolated mistakes from recurring patterns and identify the specific conceptual or procedural component from which an error originates (Lin et al., 2025; Nyoto & Mutiara, 2025; Rohimah et al., 2026).

The place-value indicator was met on 14 items, while regrouping was correctly applied on seven of the eight items that required it. These results suggest that the placement of the multiplier and the recording of the regrouped tens digit were relatively stable across this task set. Place value and regrouping are distinct constructs that can reveal different gaps in a student's understanding and therefore need to be examined separately (Jensen et al., 2024). The standard algorithm operates on one place value at each step; however, its compact form can also direct students' attention to individual digits, obscuring the values those digits represent (Van de Walle et al., 2016). Therefore, these findings are more appropriately interpreted as evidence that the participant could apply the place-value and regrouping components on the observed items, rather than as evidence of general conceptual mastery of place value.

The errors on Items 3, 10, and 11 differed from place-value alignment errors. On these three items, the participant used addition in the ones-position step while still following the written arrangement and multiplication sequence elsewhere. The interview also showed that the participant could state the multiplication operation that should have been used, although this explanation did not match the initial written work. Therefore, these errors are not best characterized as an inability to understand the entire algorithm; rather, the evidence supports an inconsistent substitution of addition for multiplication at particular steps. (Lin et al., 2025) systematic review showed that computational errors among students with mathematics difficulties can involve factual, procedural, and visual-spatial errors, with the use of an incorrect operation classified as a procedural error. Although whole-number multiplication can be understood as repeated addition of equal-sized groups, adding the two digits involved in a step only once is not equivalent to multiplication (Novikasari & Dede, 2024). This distinction is important because instructional support should not merely repeat the sequence of the algorithm; it should clarify when repeated addition represents multiplication and when using addition changes the operation that must be performed.

Item 9 revealed a more specific pattern. The participant correctly positioned the multiplier and identified the relevant place values but did not immediately retrieve the multiplication fact 3×9, recorded 27 as 72, and reconstructed the regrouping step only after probing questions. Because regrouping was correctly applied on seven other items, this single error does not support the conclusion that the participant did not understand regrouping at all. Rather, the evidence indicates vulnerability in a sequence that combined retrieving the multiplication fact, recording the digits of 27 in the correct order, and regrouping. The compact form of the algorithm, in which small digits are used to indicate regrouped values, has been reported as a source of error, whereas recording partial products can make the origin of each value more visible (Van de Walle et al., 2016). A meta-analysis of primary school students found a moderate association between working memory and arithmetic performance, including written arithmetic (Zhang et al., 2023). However, the present study did not measure the participant's working memory, processing speed, or attention. The digit reversal and need for probing questions should therefore not be attributed directly to cognitive limitations or to the slow learner label.

The discrepancy between the initial written work and the interview explanations was an important finding rather than merely noise in the data. The interview revealed that the participant could state or reconstruct some procedural knowledge even when it had not been applied independently in the initial written work. Brief interviews during or after instruction are also recommended in error analysis because they can help teachers trace the reasoning underlying students' answers and adapt instruction to students' thinking (Lin et al., 2025). Nevertheless, answers that emerged after probing questions cannot be used retrospectively to reclassify the initial performance as correct. The Inconsistent evidence status therefore preserves two pieces of information simultaneously: some of the participant's procedural knowledge could be elicited through probing, but the participant had not yet applied it independently or consistently. This distinction prevents the researcher from selecting only the more favorable interview evidence or only the weaker evidence in the written response.

The error patterns in this study overlap with those reported in previous research while also showing important differences. Hasibuan et al. (2022) identified computational, symbolic, and procedural errors when students identified as slow learners solved circle problems. In the present study, computational and procedural elements were also evident, but the participant applied the algorithm consistently on most of the computation items. Jannah et al. (2025) likewise found that two students identified as slow learners required different forms and intensities of scaffolding according to their individual difficulties. These comparisons underscore that the slow learner label is insufficient to predict the type of error made by an individual; an ability profile must be constructed from evidence specific to the content, item, and assistance conditions. Consequently, the findings from this single case do not support the generalization that all students identified as slow learners exhibit the same pattern of multiplication errors.

From a pedagogical perspective, the findings point to targeted support rather than reteaching the entire algorithm from the beginning. Components that were already applied consistently (placement of the multiplier, progression from ones to tens, and regrouping on most items) can serve as starting points. For components that remained unstable, teachers can contrast examples of multiplication and addition at the ones-position step, ask the participant to explain the factors in terms of the number of groups and the number of members in each group, and use expanded place-value notation or partial products before returning to compact notation. Developing algorithms through concrete or semi-concrete models, place-value language, and partial products is recommended to help students connect the written form with the rationale for each step (Van de Walle et al., 2016) Error analysis can also inform the selection of targeted practice, such as practicing the retrieval of multiplication facts that the participant cannot yet recall fluently and discussing incorrect sample responses so that students learn to identify the sources of their errors (Lin et al., 2025). Support should be provided gradually and tailored to individual needs because research on students identified as slow learners has shown the benefits of contextual, concrete, targeted, and responsive scaffolding matched to the type of difficulty experienced (Jannah et al., 2025; Listiawati et al., 2023; Susilo et al., 2022; Wibawa et al., 2026). For this participant, these implications can be translated into short teaching sequences: contrast 3×3 with $3 + 3$ using equal groups, and represent 27 as two tens and seven ones before connecting it to the regrouping step in 19×3. After guided practice, the teacher can use new problems completed without prompts to check whether operation selection and the recording of regrouped values become consistent. Independent responses should be documented separately from responses obtained with assistance so that subsequent support is based on what the learner can apply independently. Nevertheless, these strategies are implications derived from the findings and literature; their effectiveness was not tested in the present study.

Evidence from research on worked examples further informs these instructional implications. Barbieri et al. (2021) found that textbook tasks combining correct, incorrect, and incomplete worked examples improved equation-solving skills and error anticipation among algebra students. A broader meta-analysis found a moderate benefit of worked examples for mathematics performance, with larger effects for correct examples alone than for incorrect examples alone or mixed examples (Barbieri et al., 2023). For the present case, this evidence suggests beginning with clear, correct multiplication examples before considering selected errors for discussion. However, the algebra study and the broader meta-analysis do not establish the effectiveness of this sequence for this participant; such an adaptation would require evaluation.

The contribution of this study lies in mapping the application of the algorithm at the component and item levels and distinguishing initial performance from reconstruction after probing questions. This approach shows that incorrect final answers may arise from different processes, while success on several items does not guarantee consistency across variations in multiplication facts. Nevertheless, the study's conclusions are limited by its focus on a single participant, a single set of two-digit-by-one-digit multiplication items, and an interview conducted after task completion. The study also did not measure multiplication-fact fluency, working memory, attention, retention, or procedural transfer to contextual problems. Future research could examine multiple cases, repeat tasks at different times, systematically vary the multiplication facts, and include transfer tasks to determine whether the patterns of using addition and reversing digits are persistent or occur only under particular conditions.

CONCLUSION

The standard multiplication algorithm was generally applied but not fully consistently across the task set. Place-value alignment, the sequence from ones to tens, and regrouping were demonstrated correctly on most problems. Inconsistencies occurred when addition replaced multiplication in the ones-position step and when the digits of 27 were reversed during regrouping. Explanations elicited through probing showed that some procedures could be reconstructed, but they did not constitute independent correct application in the initial work.

These findings indicate that instructional support should focus on operation selection, multiplication-fact fluency, and accurate recording of regrouped values rather than reteaching the entire algorithm. Expanded notation, partial products, and explicit comparison of addition and multiplication may help stabilize these components. Because the evidence is limited to a single case, one task set, and one interview conducted after task completion, the findings should be interpreted contextually. Further research should examine multiple cases, repeated tasks, and transfer to contextual problems.

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