

Structure of Observed Learning Outcome-Based Assessment (Solo-based Assessment) and Algebra Competence of Learners

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Abstract

This study examined the relationship between teachers' utilization of SOLO-based assessment and the algebra competence of Grade 9 learners at Gainza National High School during the School Year 2025-2026. Using a quantitative descriptive-correlation design, data were gathered from 100 students through a validated questionnaire and a teacher-made test. This research establishes that while teachers demonstrate consistent utilization of SOLO-based assessment practices in terms of structure, sequencing of activities, and cross-subject application, this utilization does not translate into a strong influence on learners' algebra competence. The relationship between the variables is statistically significant, indicating that other factors may contribute more substantially to students' algebra performance. Furthermore, learners' competence in algebra reflects the need for strengthened instructional and assessment approaches that promote deeper conceptual understanding and higher-order thinking skills. In response, the study underscores the importance of aligning assessment design with cognitive progression. Based on these conclusions, a SOLO-based lesson guide was developed using the ADDIE model to support teachers in structuring assessment tasks, improving instructional practices, and fostering improved algebra competencies among learners.

Keywords: SOLO Taxonomy, Assessment Utilization, Algebra Competence, Quadratic Equations, Quadratic Functions

1. Introduction

Assessment is very important in education. Often, classroom practices focus on memorization and getting the right answers rather than on understanding and critical thinking. In math, this is an issue, students might be good at solving problems they have seen before, but struggle with new ones. Algebra is a subject that helps with higher mathematics and science. It shows we need to check how well students think, not just memorize. The Structure of Observed Learning Outcomes or SOLO is a tool, tracks how students think and learn by examining the quality of their answers. This helps teachers guide students from recalling facts to understanding complex ideas. This study looks at how teachers use SOLO-based assessment and its impact on Grade 9 students' algebra skills. It finds that using SOLO helps students better understand algebra concepts and think more deeply.

Likewise, education systems worldwide are shifting from traditional assessments to frameworks that emphasize cognitive progression. Correct answers alone are no longer enough to reflect how learners construct and transfer knowledge. Developed by Biggs and Collis, the SOLO taxonomy categorizes learning outcomes into five hierarchical levels: pre-structural, uni-structural, multi-structural, relational, and extended abstract, providing a systematic way to describe increasing complexity. This approach aligns with Sustainable Development Goal 4, which calls for deeper learning and qualitative shifts in thinking, making SOLO a vital tool for inclusive and transformative education.

In addition, worldwide studies strongly support SOLO's role in mathematics assessment, highlighting its effectiveness in aligning outcomes, instruction, and evaluation with cognitive growth. Reviews by Adeniji et al. (2022), Dong and Zhang (2024), Yeo (2019), and Pegg (2018) emphasize its strength in focusing on the quality of learners' responses rather than correctness alone. Similarly, studies by Bain and Schmidt (2019), Tan and Yap (2019), McKenna and McDowell (2016), and Vallecillos and Moreno (2022) demonstrate that SOLO-based assessment fosters relational understanding, reasoning, and conceptual connections, providing a strong foundation for this study's investigation into whether teachers' use of SOLO is linked to Grade 9 learners' algebra competence.

At the same time, Philippine education policies reinforce the importance of algebra competence. Republic Act 10533 mandates a curriculum centered on conceptual understanding and problem-solving, while DepEd Orders No. 8 (2015) and No. 21 (2019) identify algebraic skills as critical Grade 9 outcomes. The Philippine Professional Standards for Teachers further emphasize numeracy and higher-order reasoning. Yet, results from the Rapid Mathematics Assessment RMA reveal persistent gaps, with many learners struggling to apply algebraic concepts in real-life contexts. These challenges highlight the need for assessment frameworks that move beyond accuracy and routine procedures, and SOLO provides such a model by capturing cognitive progression.

Furthermore, both international and local studies affirm SOLO's effectiveness in strengthening reasoning and higher-order thinking. Research by Jonsson and Lindström (2015), Minikutty and Krishnan (2022), Upu and Bangatau (2019), and Zhang and Wong (2021) shows its impact on algebraic reasoning and problem-solving, while Philippine studies by Fernandez, Manalo, and Cruz (2022) and Ragudo (2024) highlight its role in moving learners beyond procedural skills toward relational and abstract reasoning. Other local studies, such as Ragunan and Santos (2021), emphasize the influence of teachers' awareness of SOLO on assessment quality, and Matanguihan and Chua (2024) demonstrate its applicability across subjects, while Regacho (2019) links teacher assessment practices to mathematics performance. Collectively, these findings reinforce the relevance of this study in examining how teachers' use of SOLO affects Grade 9 learners' algebra competence.

Ultimately, this study is significant because it explores the systematic use of SOLO-based assessment to improve Grade 9 algebra competence, an area not fully addressed in earlier research. Persistent numeracy gaps revealed in Camarines Sur through the RMA 2024 results underscore the urgency, as learners continue to struggle with problem-solving and reasoning despite proficiency in basic computations. Current practices that emphasize speed and correctness leave students unprepared for higher-order tasks

essential in advanced mathematics and science. By developing structured instructional resources such as SOLO-based lesson guides, this study aims to help teachers align assessment with cognitive progression and support lasting achievement in algebra.

2. Research Objectives

This study determined the influence of the level of utilization of SOLO-based assessment on the level of algebra competence of Grade 9 learners at Gainza National High School, Gainza District, Division of Camarines Sur. In particular, it sought to determine the level of utilization of SOLO-based assessment in terms of application across the subject areas, presentation of activities sequence and structure. It identify the level of algebra competence of learners particularly in solving quadratic equations and quadratic functions. Furthermore, the study investigated the significant relationship between the level of utilization of SOLO-based assessment and the level of algebra competence of learners, as well as the extent to which the utilization of SOLO-based assessment influences the algebra competence of learners. Finally, the research aimed to develop a SOLO-based lesson guide to enhance the level algebra competence of learners.

3. Methods

The current study employed a quantitative descriptive-correlational research design to examine the relationship between teachers' utilization of the Structure of Observed Learning Outcomes (SOLO)-based assessment and learners' competency in Algebra, ultimately leading to the development of a lesson guide. The descriptive approach was used to analyze the extent of SOLO application across subject areas, the sequencing of learning activities, and learners' competency in solving quadratic equations and functions, while the correlational method determined the significance and influence of SOLO-based assessment on learner performance. This methodological approach is supported by Creswell, J. W., & Creswell, J. D. (2018), who noted that descriptive-correlational designs are appropriate for analyzing measurable variables and their relationships, and by De Guzman and Reyes (2021), who emphasized their effectiveness in explaining how teacher practices affect student achievement. Similarly, Regacho (2017) demonstrated the value of descriptive methods in examining classroom interventions. Moreover, related studies by Prasetyo and Retnawati (2020), Taylan and Ateş (2022), and Martin and Torres (2021) revealed that structured SOLO-based tasks improve learners' accuracy, reasoning, and conceptual understanding in algebra problem-solving, while Villanueva and Santos (2022) and Reyes and Molina (2019) found that integrating SOLO into lesson design and teacher training enhances higher-order thinking and student outcomes. Collectively, these findings affirm that a systematically developed SOLO-based lesson guide can refine teaching strategies, align assessment with learning objectives, and enhance learners' algebra competencies, particularly in quadratic equations and functions.

4. Results and Discussion

The assessment and findings of this study present the results derived from data collected from learners of Gainza National High School. These results are systematically organized around the research objectives, focusing on teachers' utilization of SOLO-based assessment, learners' algebraic competency, and the

relationship between the two variables. The data are analyzed using both descriptive and inferential statistical methods, with interpretations supported by relevant literature. Overall, the findings clarify how SOLO-based assessment influences algebraic competence and serve as a basis for developing an evidence-based lesson guide.

Level of Utilization of SOLO-based Assessments. Table 1 summarizes the level of utilization of SOLO-based assessment across three aspects, with an overall weighted mean of 2.73, interpreted as Highly Utilized. The highest-ranked aspect is Application Subject Areas, with a weighted mean of 2.85, followed by Presentation of Activities Sequence, with a weighted mean of 2.79, indicating that teachers strongly emphasize contextual application and structured lesson progression. Meanwhile, the two lowest-ranked aspects are Presentation of Activities Sequence and Structure of SOLO-Based Assessment, with a weighted mean of 2.56, although both remain in the Highly Utilized category. The comparatively lower mean for structured SOLO design suggests that explicit alignment to SOLO levels may be less emphasized than contextual application. Overall, the table shows consistent and high utilization across all aspects, with slight variation in structural implementation.

Table 1: Level of Utilization of SOLO-based Assessments

Aspects	WM	Int
Application Subject Areas	2.85	HU
Presentation of Activities Sequence	2.79	HU
Structure of SOLO-based Assessment	2.56	HU
Overall Level	2.73	Highly Utilized

Note. WM refers to Weighted Mean, and Int refers to Interpretation. The interpretation is based on 1.00 to 1.75 as Low Utilized (LU), 1.76 to 2.50 as Moderately Utilized (MU), 2.51 to 3.25 as Highly Utilized (HU), and 3.26 to 4.00 as Very Highly Utilized (VHU).

The results show that teachers demonstrate strong competence in applying the SOLO approach across various subjects and in organizing learning activities in a clear and logical sequence. This means that students usually see how different subjects are connected and that the lessons are planned in a way that makes sense. On the one hand, the part that received the lowest score was the structured SOLO-Based Assessment, which means that teachers do not always ensure that the tasks they give students are aligned with the different levels of the SOLO approach. Even though teachers still use this approach a lot, the fact that it got a score suggests that there might be some gaps in how they plan their lessons. The fact that the scores are all pretty close together indicates that teachers are consistent in their teaching. It also shows that they might not always plan their lessons in a very structured way.

The findings indicate that the school is highly effective in applying the SOLO approach, particularly in real-life situations. However, if teachers made an effort to align their tasks with the different SOLO levels, it could really help students learn more deeply. Even though teachers are already using the SOLO approach widely, changing how they plan their lessons could help students start thinking in more relational and

abstract ways. The results suggest that if teachers received training on using the SOLO taxonomy and planning their lessons, it could help them teach more effectively. So if the school can make the SOLO approach an intentional part of their teaching, it could lead to even better results for students.

These findings are supported by studies showing how important it is to teach things in a way that makes sense and to have a clear plan. Sujatha and Vinayakan (2023) said that when you teach mathematics in a way that relates to the world students get more interested which is what we want when we focus on applying what we learn. Kiyani et al. (2025) found that progressing from easy to hard activities helps students get ready and understand better, which is similar to what we do when we present activities in an order. Benson-O'Connor et al. (2019) said that learning things one after the other helps us understand better, which is what we mean by making sure our lessons follow an order. Odoh et al. (2025) showed that when we design tests to help students solve problems and think critically, which is connected to the fact that we do not always ensure our tests follow the SOLO structure, we might need to work on that.

The analysis makes sense because of the SOLO Taxonomy Theory, which provides a way to structure what students learn, from simple to complex. The results show that we are good at teaching things in a way that makes sense and in an order, which is what the theory says we should do to help students move from just knowing facts to really understanding them. However, we do not always make sure that what we teach follows the SOLO structure, so even though we are good at teaching things in a way, we might not be as good at making sure students learn in a way that follows the SOLO levels. If we use Biggs theory more on purpose, it could help students think deeply and make connections between things, and have tests that are designed to help them do that.

Competency Level of Learners in Quadratic Equations and Quadratic Functions. Table 2 illustrates the learners' level of competency in Algebra based on two major competencies: Quadratic Equations and Quadratic Functions. The overall mean score is 16.55 with a proficiency level of 55.17%, interpreted as Approaching Proficiency. Among the competencies, Quadratic Equations obtained the highest mean of 8.56, Standard Deviation of 2.65, and proficiency level of 57.07%, while Quadratic Functions recorded a slightly lower mean of 7.99, Standard Deviation of 2.78, and proficiency level of 53.27%. Both competencies fall within the Approaching Proficiency range (50.0–74.9). The results indicate that learners demonstrate developing understanding but have not yet reached full mastery of algebraic concepts. Overall, the data suggest moderate performance across both domains of quadratic concepts.

Table 2: Learners' Level of Competency in Algebra

Competencies	Items	Mean	SD	PL	Int	Rank
Quadratic Equations	15	8.56	2.65	57.07	AP	1
Quadratic Functions	15	7.99	2.78	53.27	AP	2
Overall	30	16.55	4.88	55.17	Approaching Proficiency	

Note. PL refers to Proficiency Level, and Int refers to Interpretation. Thus, the Interpretation values are based on the following ranges: 75.0 to 100 = Proficient (P); 50.0 to 74.9 = Approaching Proficiency (AP); 25.0 to 49.9 Developing (D); and 0 to 24.9 = Beginning (B).

This trend demonstrates that learners can perform common tasks and use basic algebraic procedures. But their knowledge may be scattered rather than fully integrated. The higher performance on quadratic equations suggests that learners are more adept at procedural and sequential problems presented more explicitly. On the other hand, the comparatively lower performance in quadratic functions showed difficulty in understanding abstract relationships, representing, and applying things in real life. A possible reason for this is that function learners require more cognitive energy than non-function learners (graphs, varying values, and the resulting functional relationship, etc.). These differences suggest that procedural fluency may receive adequate support from instruction, although deeper conceptual understanding and the transfer of knowledge are not consistently promoted.

This result indicates that students are in the intermediate level of either developing or proficient algebraic understanding. The approaching proficiency level indicates that lessons may encourage a shallow, multi-structurally focused understanding, but may not yet effectively foster relational and extended abstraction. The lower scores in quadratic functions suggest deeper conceptual understanding, and application should be pursued. Enhancing cognitive scaffolds and structured assessment strategies will support students in bridging procedural understanding to conceptual meaning. Therefore, purposeful interventions that target relational understanding could enhance proficiency in algebra overall.

In this regard, the results of this study, which show that learners are at the level of Approaching Proficiency, are in line with the literature on algebra levels of performance. According to Adeniji, Baker and Schmude (2022), many learners possess procedural competence but fail to develop relational understanding unless there is structure for support in such areas. Likewise, Ghunaimat and Alawneh (2024) found that students performed more proficiently in routine equation-solving than in functional applications, which suggests a weakness in deeper reasoning. Yang and Sianturi (2021) highlighted the need for explicit scaffolding and higher-order questioning in moving towards relational thinking. In line with this, Sari and Darhim (2018) found reduced performance with quadratic functions due to their abstract nature. Taken jointly, these reports further affirm the prevailing conclusion that students are still in the process of becoming more aware of the task and will need instruction in alignment to make thinking process better.

The evidence is presented based on the Structure of Observed Learning Outcomes (SOLO) concept, which posits that those learners advance from unistructural and multi-structural stages into relational and extended abstract thought. The Approaching Proficiency classification indicates that learners are operating mainly at the multi-structural level, which refers to the process of learning a skill in a context where the skills have been formed, but not necessarily integrated in a coherent conceptual framework. Comparably lesser performance in quadratic functions represents a few relational associations between algebraic representations and the underlying concepts. So applying the SOLO framework to instructional design can help design task structures that intentionally lead students to relational and extended abstract levels. With

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The significant relationship between SOLO-based assessment utilization and learners' algebra competency was analyzed using a student survey (measuring application, activity sequencing, and structural alignment) and a teacher-made test on quadratic equations/functions. Data were analyzed via Pearson r in JAMOVI at $\alpha=0.05$. Table 4 shows all $p < 0.05$ (significant), but very low r -values: highest $r=0.269$ (Structured SOLO and Quadratics, $p=0.049$); lowest $r=-0.217$ (Activity Sequence and Quadratics, $p=0.008$); overall $r=0.059$ ($p=0.025$), indicating minimal association strength despite significance.

Table 3: Significant Relationship between the Utilization of SOLO-based Assessment and Competency of Learners in Algebra

Utilization of SOLO-based Assessment	Learners' Competency	r-value	Int.	p-value	Int.
Application Subject Areas	Quadratic Equations	0.126	VL	0.021	Sig.
	Quadratic Functions	0.123	VL	0.023	Sig.
Presentation of Activities Sequence	Quadratic Equations	-0.217	VL	0.008	Sig.
	Quadratic Functions	-0.133	VL	0.018	Sig.
Structure of SOLO-based Assessment	Quadratic Equations	0.269	VL	0.049	Sig.
	Quadratic Functions	0.053	VL	0.005	Sig.
Overall Level		0.059	Very Low	0.025	Significant

Note. Int. refers to interpretation, Sig. refers to Significant, N/A refers to Not Applicable, and N.Sig. refers to Not Significant. The r -value interpretation is based on the following: 0.90 to 0.99 as Very High Correlation (VH); 0.70 to 0.89 as High Correlation (H); 0.50 to 0.69 as Moderate Correlation (M); 0.30 to 0.49 as Low Correlation (L); and 0.01 to 0.29 as Very Low Correlation (VL). While the p -value is interpreted as Significant when < 0.05 .

Reviewing the two most prominent relationships reveals that the Structured SOLO-Based Assessment and the Quadratic Equations and Application Across Subject Areas show positive, albeit very weak, correlations. Hence, structured cognitive alignment and situational application possibly do slightly

increase procedural performance of quadratic equations. On the contrary, the negative yet very weak correlations observed with the two lowest relationships presented as Presentation of Activities Sequence and Quadratic Equations and Presentation of Activities Sequence and Quadratic Functions. The negative direction might indicate variability in instructional pacing or divergence from sequencing to the readiness level. Although statistically significant, the very low r -values suggest only slight practical significance. Hence if SOLO utilization is connected with algebra competence, the relation is not of a large or significant nature.

The data shows that utilization of SOLO-based assessment has a relatively measurable but weak association with learners' algebra performance. This reinforces our conclusion that structured alignment of tasks contributes more positively than sequencing practices on their own do. The negative correlations in presentation sequence may indicate the need for purposefully paced, cognitive scaffolding. Since all correlations are extremely low, other instructional and learner-focused variables likely have a stronger impact on competency. Therefore, SOLO-based assessment should be considered a complementary process, rather than a leading factor for the algebra achievement outcome. An emphasis on fidelity and depth of application could increase its teaching impact.

The findings indicate a significant but very low correlation between utilization SOLO-based assessments and students' proficiency in algebra and support a growing body of literature, which demonstrates the significance of the relationship between pedagogical strategies and student performance. Sujatha and Vinayakan (2023) also highlighted that the use of context in the application of mathematics can increase engagement but not necessarily the level of proficiency being achieved; this finding indicates weak correlation. Kiyani et al. (2025) suggest sequencing activities promote scaffolding, but their benefit in developing algebraic depth is weak unless accompanied by strong conceptual alignment, which is consistent with the lack of correlation seen in activity sequencing. Benson-O'Connor et al. (2019) found that while cumulative learning facilitates comprehension only when aligned to cognitive frameworks, thus clarifying the lower structural emphasis in the results. Odoh et al. (2025) found that structured assessment strategies can serve as bridging mechanisms between procedural and conceptual gaps, suggesting that explicit SOLO alignment — least emphasized yet potentially to have an even stronger impact on competency — can address the task at hand.

The results are well aligned with Biggs and Collis' SOLO Taxonomy Theory, which states that learning progresses from shallow to deep and long-lasting abstract understanding when tasks are systematically arranged at cognitive levels. Such low correlations imply that SOLO-based practices may exist, but they are practice-led and thus more practice-less than structurally grounded in affecting students' algebraic abilities. SOLO theory suggests that there should be explicit alignment of tasks with hierarchical levels to promote relational and extended abstract thought, thereby accounting for the fact that structural engagement influenced slightly more than contextual engagement. Algebraic proficiency deepens with the adoption of more purposeful SOLO in assessment implementation, furthering the overall algebraic depth of learners as they move towards higher-order conceptual fluency rather than procedural fluency.

SOLO-based assessment influenced the competency level of learners in Algebra among the teachers. Using a survey and a teacher-made test, the study examined the effect of teachers' utilization of SOLO-

based assessment on algebra students’ competency levels. The survey assessed teachers’ alignment between the SOLO concepts and the activities in each subject area of learning by focusing on individual activity sequencing, task alignment, and test results, which were primarily focused on pupils’ skills in solving quadratic equations and functions. Responses and scores were encoded and analyzed, and the coefficient of determination (r^2) was computed with JAMOVI to determine how SOLO-based assessment could account for variations in algebra performance.

Table 4 shows the extent of influence of SOLO-based assessment utilization on learners’ competency in Algebra using r^2 values. All computed r^2 values fall within the Very Weak range of 0.00–0.19. The strongest influence is observed in the Structured SOLO-Based Assessment on Quadratic Equations, which has an r -value of 0.269, a coefficient of determination of 0.072, indicating that 7.2% of the variance in performance is explained by this aspect. This is followed by the Presentation of Activities Sequence on Quadratic Equations with a coefficient of determination of 0.047, explaining 4.7% of the variance. The lowest influence is recorded in Structured SOLO-Based Assessment on Quadratic Functions, with a coefficient of determination of 0.003 and an Overall Level coefficient of determination of 0.003, both explaining only 0.3% of the variance. Overall, the table shows that while influence exists, it remains minimal across all aspects.

Table 4: Extent of Influence of Utilization of SOLO-based Assessment on Learners’ Competency in Algebra

Utilization of SOLO-based Assessment	Learners' Competency	r-value	r ² -value	Int.
Application Subject Areas	Quadratic Equations	0.126	0.016	VW
	Quadratic Functions	0.123	0.015	VW
Presentation of Activities Sequence	Quadratic Equations	-0.217	0.047	VW
	Quadratic Functions	-0.133	0.018	VW
Structure of SOLO-based Assessment	Quadratic Equations	0.269	0.072	VW
	Quadratic Functions	0.053	0.003	VW
Overall Level		0.059	0.003	Very Weak

Note. The r^2 -value interpretation is based on the following: 0.80 to 1.00 as Very Strong Influence (VS); 0.60 to 0.79 as Strong Influence (S); 0.40 to 0.59 as Moderate Influence (M); 0.20 to 0.39 as Weak Influence (W); and 0.00 to 0.19 as Very Weak Influence (VW).

Further analysis illustrates the Structured SOLO-Based Assessment on Quadratic Equations & the Presentation of Activities Sequence on Quadratic Equations for Structured SOLO shows the second strongest level and also indicates a little more effect of systematic alignment in the learning process and teaching method on procedural performance. But explained variance remains at least in the very weak part of the range at all, suggesting little predictability. The two least significant influences, Structured SOLO-Based Assessment on Quadratic Functions and Overall Level, however, both of whom have negligible explanatory power. Despite the low r^2 values which are consistent, they indicate that the majority of learners’ competence variance is due to non-SOLO-related mechanisms. While certain factors exert

comparatively more impact than others, none is moderate or high-impact. Hence, SOLO-based assessment explains only a small portion of the results of algebra performance.

From such findings, we can conclude that the use of SOLO-based assessment affects learners' algebra competency in a measurable manner, however weakly. Structured alignment looks like the most significant improvement, at least for procedural tasks like quadratic equations. However, because its explanatory power is limited, it indicates that implementation depth, quality of instruction, learner motivational factors, previous knowledge and contextual factors may serve as more significant mediators of achievement. The low impact on quadratic functions indicates that more cognitive scaffolding is necessary for conceptual reasoning. Thus, SOLO-based assessment must be reinforced and augmented with other evidence-based interventions to make a difference. Therefore, increased fidelity and intentionality in implementing the strategy may serve to increase its effect on learner achievement rates.

Conveying that the influence of SOLO-based assessment utilization to learners' algebra proficiency is weak is consistent with a number of recent studies. According to Adeniji, Baker, and Schmude (2022), although SOLO-informed pedagogic approaches enhance mathematical reasoning, the statistical impact to achievement levels of SOLO is low when not strictly adopted. Likewise, structured assessment frameworks account for only a small amount of the variance in mathematics performance as learner-related and contextual factors are found to influence achievement (Ghunaimat & Alawneh, 2024). According to Yang and Sianturi (2021), hierarchical questioning strategies in terms of effect upon which all-out effectiveness increases with time when incorporated into daily teaching and not only used relatively shallowly, as the hierarchical questioning strategies cannot truly do much of the work if their use in this area of study, only becomes important (Yang and Sianturi (2021). Moreover, Sari and Darhim (2018) noted that enhanced quadratic reasoning skills require continued conceptual scaffolding beyond assessment alignment is necessary and not one that only leads to a better understanding of the scaffold.

These results collectively bear that out for that when measured against the existing body of literature suggest that, while use of SOLO-based usage contributes to performance in algebra, combined, there is less evidence that SOLO serves to explain why the effects of SOLO-based utilization is significantly related to algebra performance as a consequence, as SOLO only explains in isolation. Results are also substantiated with support from the Structure of Observed Learning Outcomes (SOLO) Taxonomy suggesting that learners develop increasingly through hierarchical cognitive levels, from surface up, then through deep learning. The very low r^2 values indicate that adoption of SOLO-oriented assessment frameworks does not guarantee the advancement toward relational and extended abstract thinking per se, by simply using SOLO-aligned assessment structures. As the theory maintains, meaningful advancement depends on a planned task design, regular scaffolds, and reflective engagement to stimulate cognitive restructuring. This stronger impact found in organized alignment for quadratic equations suggests that some steps at the multi-structural stage of learning have taken place, however movement toward the relational is limited. Thus, the application of SOLO theory indicates that deeper more sustained integration of instruction is a key factor in helping to significantly improve learners' algebra understanding.

This lesson guide utilizes a Modified ADDIE model, with a focus on the Analysis, Design, and Development phases of the ADDIE process, to provide an orderly, focused learning environment and

outcomes-focused form of learning material. In the Analysis phase, students' prior knowledge, misconceptions as well as their readiness levels in algebra were analysed for the purpose of establishing instructional objectives. The Design phase applied these ideas to objectives, in order sequence of activities and the assessment strategy that scaffolded the student's progression from basic abilities to higher-level reasoning. The Development phase concentrated on creating and improving teaching and learning materials in accordance with curriculum standards, best practice approach and learner diversity. This format makes the use of a SOLO (Structure of Observed Learning Outcomes) taxonomy, a hierarchical framework around cognitive growth, more comprehensive. SOLO helps move lessons from unistructural and multi-structural: those in which learners learn and make connections between them to relational and extended abstract levels where they explore constructs and apply them across contexts. Through the implementation of SOLO in the lesson progression, the guide encourages incrementally advancing from procedural fluency to conceptual mastery, prompting learning through higher-order thinking processes (e.g., generalization and abstraction) and knowledge transfer. In relation with quadratic equations, it refers to the progression of students in the understanding of the graphical representations of equations, the discovery of relationships between equations and their applications to real-world problems. So combining ADDIE and SOLO not only promotes the alignment of instruction but also cultivates deeper, more secure learning experiences that align with recent educational research regarding effective mathematics education.

Conclusions

1. The level of utilization of SOLO-based assessment in terms of application across subject areas, presentation of activity sequences, and structure is Highly Utilized, with stronger emphasis on contextual application and sequencing than on explicit structural alignment to SOLO levels.
2. The competency level of learners in Algebra, particularly in quadratic equations and quadratic functions, is classified as Approaching Proficiency, indicating developing but not yet fully mastered algebraic understanding.
3. There is a statistically significant but very weak relationship between the level of utilization of SOLO-based assessment and the level of competency of learners in Algebra, reject the null hypothesis
4. The extent of influence of SOLO-based assessment utilization on learners' competency in Algebra is very weak, explaining only a small proportion of variance in learners' performance, accept Alternative hypothesis
5. A SOLO-based Lesson Guide was developed to enhance structured cognitive progression, strengthen conceptual understanding, and improve learners' Algebra competencies.

Recommendations

1. School administrators should strengthen monitoring and mentoring systems to ensure consistent implementation of SOLO-based assessment. Professional development activities and LAC sessions should focus on designing sequenced tasks aligned with SOLO levels, while teachers should improve pacing to support deeper learner understanding.
2. Mathematics teachers should implement targeted remediation and enrichment activities to improve

learners' conceptual understanding of quadratic equations. Differentiated strategies and regular formative assessments aligned with SOLO levels should be used to monitor and support learner progress.

3. Teachers should ensure strong alignment between learning objectives, activities, and assessments to enhance higher-order thinking skills. Collaborative lesson planning and focused instructional supervision should be encouraged, along with validation of assessment tools.
4. Teachers should integrate SOLO-based assessment with other effective strategies such as problem-based learning and contextualized teaching. Emphasis should be placed on deep implementation, supported by continuous training and classroom-based action research.
5. The developed lesson guide should be pilot-tested, refined, and contextualized before full implementation. Additional instructional materials may be developed, and future studies should explore technology integration and long-term effectiveness in improving Algebra competencies.

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