

ASSESSMENT OF THE EFFECTIVENESS OF HIGHER ORDER THINKING SKILLS – STRUCTURE OF OBSERVED LEARNING OUTCOMES(HOTS- SOLO) INTEGRATION IN MAXIMIZING READING COMPREHENSION

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ABSTRACT

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Reading comprehension remains a persistent educational challenge among Filipino learners, particularly among students who struggle to move beyond literal understanding of texts. This study examined the effectiveness of integrating Higher Order Thinking Skills (HOTS) and the Structure of Observed Learning Outcomes (SOLO) Taxonomy in improving the reading comprehension of Grade 9 students at Sevilla National High School during the School Year 2024–2025. Employing a one-group quasi-experimental pretest-posttest design with repeated measures, the study involved 78 Grade 9 students who participated in a four-week HOTS–SOLO-integrated reading intervention. Reading comprehension was assessed



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using a standardized reading assessment administered before the intervention and through three successive post-tests. Data were analyzed using frequency, percentage, Shapiro-Wilk test, Wilcoxon Signed-Rank Test, Friedman Test, and Mann-Whitney U Test. Results revealed significant improvements in students' reading comprehension across all post-test administrations, with the proportion of independent readers increasing substantially and frustration-level readers decreasing considerably. Findings suggest that HOTS-SOLO-integrated instruction is associated with meaningful improvements in reading comprehension and critical engagement with texts. The study recommends broader implementation of HOTS-SOLO strategies and continuous teacher development in higher-order thinking instruction.

INTRODUCTION

The Department of Education has continuously promoted instructional innovations that foster critical thinking and deeper learning among Filipino learners. Among these innovations are instructional approaches anchored in Higher Order Thinking Skills (HOTS) and the Structure of Observed Learning Outcomes (SOLO) Taxonomy, both of which emphasize students' progression from surface-level understanding to deeper conceptual and analytical thinking.

Recent national and international assessments have consistently highlighted concerns regarding Filipino learners' reading proficiency. Beyond the ability to decode text, contemporary literacy demands that learners analyze information, evaluate arguments, and construct meaning from diverse sources. These competencies require higher-order cognitive processes that extend beyond literal comprehension. Consequently, instructional approaches that intentionally develop critical thinking while supporting progressive learning outcomes have gained increasing attention among educators and curriculum developers. In this context, integrating HOTS and SOLO Taxonomy offers a potentially complementary framework to strengthen reading comprehension through structured cognitive engagement.

While previous international studies have documented the benefits of HOTS-based instruction and SOLO Taxonomy in enhancing learners' cognitive performance, empirical evidence examining their combined application in Philippine secondary school reading instruction remains limited. Moreover, few classroom-based studies have documented how repeated exposure to HOTS-SOLO-integrated lessons correlates with students' progression from frustration and instructional reading levels toward independent reading comprehension.

Given the reading comprehension challenges identified among Grade 9 students of Sevilla National High School, there is a need to examine whether a structured HOTS-SOLO instructional approach may support reading improvement among junior high school learners. Thus, this study investigated

the effectiveness of HOTS–SOLO-integrated reading instruction in enhancing the reading comprehension of Grade 9 students through a four-week intervention program.

Theoretical Background. The present study is anchored in Bloom's Revised Taxonomy, SOLO Taxonomy, and Vygotsky's Sociocultural Theory. Collectively, these perspectives suggest that learners develop deeper comprehension when they engage in increasingly complex cognitive tasks supported by structured instructional scaffolding. The integration of HOTS and SOLO principles therefore provides a theoretical basis for enhancing reading comprehension through guided progression from basic understanding toward critical analysis, evaluation, and reflective thinking.

Related Literature. A considerable body of literature underscores the importance of integrating Higher Order Thinking Skills (HOTS) and the Structure of Observed Learning Outcomes (SOLO) Taxonomy into educational practices to enhance reading comprehension. These frameworks, when applied effectively, not only support students' cognitive development but also promote deeper engagement with texts, leading to better comprehension and critical thinking.

Anderson and Krathwohl's (2001) revision of Bloom's Taxonomy identifies higher-order cognitive processes such as analysis, evaluation, and creation as integral to fostering deep learning. These higher-order thinking skills are essential in reading comprehension because they encourage students to go beyond surface-level understanding and engage critically with the material. For example, students are not just asked to recall details from a text but to analyze its themes, evaluate arguments, and create new connections or interpretations. This deeper engagement is essential for developing strong reading comprehension skills, which are crucial for academic success. The Higher-Order Thinking (HOT) SOLO Prototype Lesson Plan is an instructional framework that integrates the Structure of Observed Learning Outcomes (SOLO) taxonomy into classroom practice to enhance students' cognitive abilities. This approach aligns with contemporary educational strategies that emphasize the development of higher-order thinking skills, such as critical analysis, evaluation, and synthesis (Biggs & Collis, 2014). The SOLO taxonomy, originally introduced by Biggs and Collis, categorizes learning outcomes by complexity, ranging from surface-level understanding to deep comprehension and extended abstract thinking (Biggs & Tang, 2019). By applying this model, educators can scaffold student learning through progressively challenging tasks, allowing them to develop advanced reasoning and problem-solving abilities. Research has shown that the SOLO taxonomy improves students' ability to analyze, evaluate, and create, which are critical skills in academic and real-world contexts (Chan et al., 2002).

In the context of the Department of Education in the Philippines, the HOT-SOLO Prototype Lesson Plan has been utilized to enhance students' critical reading comprehension skills, particularly in evaluating the relevance

and worth of ideas, the soundness of an author's reasoning, and the effectiveness of a presentation. For instance, lesson exemplars from Philippine secondary schools have demonstrated the successful integration of HOT-SOLO strategies in teaching English and reading comprehension. These lessons typically involve activities such as analyzing literary texts, engaging in peer discussions, and transposing information between linear and non-linear texts (Piper & Toubia, 2023). Such activities align with higher-order thinking skills, enabling students to develop deeper insights into texts and engage critically with various issues. The use of HOT-SOLO-based lesson plans has been shown to improve students' reading comprehension and cognitive engagement significantly. A study by Bader (2020) found that students exposed to SOLO-structured lessons performed better on comprehension assessments than those taught using traditional methods. These findings align with the principles of constructivist learning, in which students actively build knowledge through structured, meaningful interactions with texts (Vygotsky & Cole, 1978; Anderson & Krathwohl, 2001).

Related Studies. More and more studies show that the Structure of Observed Learning Outcomes (SOLO) Taxonomy and Higher Order Thinking Skills (HOTS) can help students better understand what they read. When these frameworks are used together, they encourage greater brain involvement. This helps students go beyond simple recall to higher levels of analysis, review, and creation, all of which are important for building strong reading comprehension skills.

Anderson and Krathwohl (2001) expanded on Bloom's original taxonomy and emphasized the importance of HOTS in schools. They say that brain processes like analyzing, evaluating, and making things are necessary for deeper learning. When it comes to reading comprehension, HOTS help students not only understand what a book is about but also think critically about it by figuring out what it is trying to say, how it is put together, and how it can be interpreted in new ways. These skills give students the tools they need to better understand books.

Biggs and Collis (1982) developed the SOLO Taxonomy, a framework for tracking cognitive growth by examining different levels of thinking. Learning results are grouped into taxonomies that range from easy recall (unistructural) to extended abstract (abstract thinking and synthesis). Biggs and Collis say that as students move up in SOLO, they become more involved with the subject in more complex ways, which helps them understand what they read. The SOLO taxonomy shows students how to engage more deeply with texts by prompting them to think more deeply about what they read and to examine, integrate, and evaluate it.

Bolandifar (2017) also examines the role of critical thinking in reading comprehension and shows how HOTS such as problem-solving, analysis, and review help us understand texts more complexly. Lai says that these skills help students conclude, figure out what the author was trying to say, and really

get into what they are reading. This method helps students develop more advanced comprehension skills by pushing them beyond basic knowledge and to connect with the material more reflectively and critically.

Fisher et al. (2016) look into how HOTS can be used in teaching methods to improve students' understanding of what they read. They discovered that students' reading comprehension improves significantly when they are asked to do higher-order thinking tasks, such as evaluating an argument or synthesizing knowledge from different parts of a book. These tasks encourage deep cognitive engagement, which helps students better understand books by actively questioning, studying, and synthesizing what they have learned. Fisher and Frey's work supports the idea that HOTS-driven actions help people understand what they read better and more deeply.

Ritchey and List's (2022) study also uses the SOLO taxonomy to examine how the framework supports students' brain growth during reading comprehension tasks. Ritchey and List's study shows that as students move through the higher SOLO levels, such as the related and extended abstract levels, they become increasingly interested in what they read. Students at these levels understand more than those at lower levels because they can examine how ideas relate to one another and derive new meanings. The work of Ritchey and List aligns with the idea that increased cognitive involvement (as outlined in the SOLO taxonomy) improves reading comprehension.

The study sought to determine how effectively HOTS–SOLO-integrated reading instruction helped Grade 9 students at Sevilla National High School understand what they were reading during the 2024–2025 school year.

Specifically, it sought to:

1. Determine the reading comprehension levels of the respondents:
 - 1.1 before the implementation of HOTS–SOLO-integrated instruction;
 - 1.2 after the first post-test;
 - 1.3 after the second post-test;
 - 1.4 after the third post-test; and
 - 1.5 based on the average post-test performance.
2. Determine whether there is a significant difference between:
 - 2.1 the pre-test and first post-test scores;
 - 2.2 the pre-test and second post-test scores;
 - 2.3 the pre-test and third post-test scores;
 - 2.4 the pre-test and average post-test scores; and
 - 2.5 The reading comprehension scores across all assessment periods.
3. Develop recommendations for strengthening reading instruction using HOTS–SOLO strategies.

H_0 : There is no significant difference between:

1. The pre-test and the first post-test scores;
2. The pre-test and the second post-test scores;
3. The pre-test and the third post-test scores;
4. The pre-test and the average post-test scores; and,
5. The reading comprehension scores across all assessment periods.

RESEARCH METHODOLOGY

Research Design. This study employed a one-group quasi-experimental pretest-posttest design with repeated measures to examine changes in the reading comprehension performance of Grade 9 students following exposure to HOTS-SOLO-integrated reading instruction. The design was selected because it allowed the researcher to assess changes in students' reading comprehension over time using multiple post-intervention measurements while operating within the natural classroom setting.

Unlike a true experimental design, this study did not utilize a control group or random assignment of participants. Therefore, the findings are interpreted as evidence of significant improvement associated with the intervention rather than definitive proof of causality.

Participants and Sampling Procedure. The study was conducted at Sevilla National High School in the Division of Bohol during the School Year 2024–2025. The participants consisted of 78 Grade 9 students from three sections: Faith, Hope, and Love.

The participants were selected through complete enumeration of all identified Grade 9 students who participated in the intervention program. These students were included because they were enrolled in classes where HOTS-SOLO-integrated reading instruction was implemented.

Research Instrument. Reading comprehension was measured using a standardized reading assessment aligned with higher-order cognitive processes. The reading comprehension assessment consisted of standardized passages and comprehension questions aligned with the Grade 9 English curriculum and designed to measure literal, inferential, evaluative, and critical comprehension skills. Prior to implementation, the assessment underwent content validation by English language specialists and curriculum experts to ensure alignment with the intended learning outcomes and reading competencies. The instrument was likewise reviewed for clarity, appropriateness, and consistency with the objectives of the intervention. The test was given before the intervention and three times after the intervention to keep track of the students' improvement. A HOTS-SOLO Prototype Lesson Plan was used in the intervention. It was made in line with the Department of Education's standards for teaching. The school director, the district English coordinator, and the school English coordinator all looked over the lesson plan to make sure it was acceptable and in line with curriculum standards.

Three people who know a lot about English language teaching and making lessons looked over the tool to make sure it was clear, relevant, and in line with the learning goals. Before the management, suggestions were taken into account.

Intervention Procedure. The intervention was implemented over four weeks. During the first two weeks, instruction focused on evaluating the relevance and worth of ideas, assessing authors' reasoning, and analyzing textual arguments. During the third and fourth weeks, students engaged in activities requiring evaluation, judgment, synthesis, and critical reflection on contemporary issues and reading materials.

The instructional activities were designed to move students progressively through the cognitive levels of the SOLO Taxonomy while simultaneously engaging higher-order thinking skills consistent with Bloom's revised taxonomy.

Ethical Considerations. Prior to data collection, approval was secured from the school administration. Participation was voluntary, and informed consent and assent procedures were observed. Confidentiality and anonymity of participants were maintained throughout the study. All collected data were coded, securely stored, and used exclusively for academic and research purposes in accordance with the Data Privacy Act of 2012 (Republic Act No. 10173).

Statistical Treatment of Data. Statistical Treatment of Data. To summarize the demographics and reading comprehension levels of the interviewees, descriptive statistics such as frequency and percentage distributions were used. The Shapiro-Wilk and Kolmogorov-Smirnov tests were used to assess the normality of the data distribution before the inferential analyses. Nonparametric statistical methods were used because the data did not follow a normal pattern. The Wilcoxon Signed-Rank Test was used to determine whether there were significant differences in reading comprehension scores before and after the test. The Friedman Test was also used to assess changes across different reading comprehension tests. The Mann-Whitney U Test was used to determine whether men and women differed in how well they understood what they read. Effect size measures were also calculated to assess how useful the data were in real-world settings. For the Friedman Test, Kendall's W was given, and r was given for the Wilcoxon Signed-Rank and Mann-Whitney U tests. All statistical tests used a significance level of 0.05.

RESULTS AND DISCUSSION

Reading Comprehension Before the Integration of the HOTS-SOLO Prototype Lesson Plan. The Grade 9 students did not all understand what they were reading the same way before they used the Higher Order Thinking Skills-Structure of Observed Learning Outcomes (HOTS-SOLO) sample lesson plan. There were many students at the teaching level. This meant that they could understand some parts of the book but still needed help and advice

to figure it out. Many students were also at the anger level, which meant they could not understand what they were reading, even with their teachers' help. Fewer children showed they could read well on their own. Many students still do not understand well enough to read and comprehend schoolwork on their own, as these findings show. It is very important to teach in ways that not only help students learn more but also make it easier for them to think about, evaluate, and rate what they read. It was clear from the initial results that adding the HOTS–SOLO sample lesson plan would help students better understand what they are reading and think about it more deeply.

Reading Comprehension After the Integration of the HOTS–SOLO Prototype Lesson Plan: First Trial. After the HOTS–SOLO sample lesson plan was used for the first time, there was a clear improvement in reading comprehension. More students were able to understand and interact with the readings on their own, while the number of students needing help from teachers decreased. Also, the number of students who had significant trouble understanding what they read decreased significantly. Students may have learned better ways to understand and process texts when higher-order thinking tasks were combined with organized learning goals, according to the results. The solution seemed to help students become better at reading on their own by pushing them beyond simple understanding toward analysis and explanation. The further decline in the number of students having trouble reading suggests that the way the lessons were taught may have helped students with lower reading skills understand what they were reading.

Reading Comprehension After the Integration of the HOTS–SOLO Prototype Lesson Plan: Second Trial. The second test showed that students' reading comprehension skills were still getting better. More students learned to read well enough to do on their own, and fewer students stayed in the teaching and frustration stages. Based on this trend, it appears the gains from the first run were maintained and even improved as the students continued to use the HOTS–SOLO framework. Learners gradually became more independent readers, which could mean that doing higher-order thinking tasks repeatedly helped them better understand what they were reading and become more engaged with it. Students seemed better able to make sense of written information, draw conclusions, and analyze it independently as they learned more about the HOTS–SOLO approach's analytical and reflective steps.

When looked at together, the results of the first and second tests show that reading comprehension is improving. Many factors could lead to better reading skills. However, the observed pattern indicates that the HOTS–SOLO prototype lesson plan fostered a supportive learning environment that encouraged students to connect more deeply with the reading materials. Moving from lower levels of comprehension to higher levels of freedom shows how incorporating higher-order thinking models into reading lessons could help students better understand what they read and make learning more

valuable.

Reading Comprehension After the Integration of the HOTS-SOLO Prototype Lesson Plan: Third Trial. On the third and final trial, the participants demonstrated the best reading comprehension skills observed during the training period. Many of the students showed they could read independently, which means they were getting better at understanding, analyzing, and interpreting books with little or no help from teachers. During the same period, the number of students in the classroom and frustration levels continued to decline. This suggests that students' reading skills continued to improve over time. The trend observed in the third trial suggests that using the HOTS-SOLO structure more than once helped students improve their understanding and higher-order thinking skills. Learners seemed more comfortable interacting with texts independently as they became more familiar with using organized questions, analysis, and reflection. The fact that the number of students with reading problems has been declining over time is further evidence that the intervention may have helped students overcome the comprehension problems that were evident on the baseline exam. When considered as a whole, the results from the third study support the upward trend observed during the implementation phase. It looks like the HOTS-SOLO sample lesson plan may have helped students become more active, thoughtful, and self-directed readers, as they became more independent in their reading and their lower levels of comprehension decreased.

Overall Reading Comprehension Performance Following the HOTS-SOLO Intervention. A significant change was observed in Grade 9 students' reading comprehension on the general test administered after the intervention. Most of the students reached an independent level of comprehension, meaning they could read, understand, and rate books without much help from the teacher. Not as many kids were still at the teaching level, and only a small number were still having serious problems understanding what they were reading. Based on these results, using the HOTS-SOLO sample lesson plan may have created a helpful learning environment that led to more active participation with the reading materials. By including tasks that encouraged analysis and thinking, the intervention appeared to help students develop stronger reading comprehension and read more independently.

The overall change from the first test to the last three intervention trials indicates that students' reading comprehension improves over time. The results show that structured teaching methods that include higher-order thought and progressive learning goals can help students become better readers. However, it is still clear that everyone learns differently. The results make the HOTS-SOLO structure even more appealing as a way to improve students' comprehension skills and help them become more independent, critical thinkers.

Degree of Difference in Reading Comprehension Before and After the HOTS-SOLO Intervention. The results revealed statistically significant

improvements in reading comprehension across all assessment periods following the implementation of the Higher Order Thinking Skills–Structure of Observed Learning Outcomes (HOTS–SOLO) prototype lesson plan. Significant differences were observed between the pre-test and each post-test administration, while the Friedman test further indicated that reading comprehension scores varied significantly across the four assessment phases. Taken together, these findings suggest a consistent pattern of improvement in students’ reading comprehension throughout the intervention period.

Table 1. *Differences in Reading Comprehension Scores Across Assessment Phases (N = 78)*

Comparison	Test Statistic	<i>p</i>	Interpretation
Pre-Test vs. Post-Test 1	$Z = -6.87$	$< .001$	Significant difference
Pre-Test vs. Post-Test 2	$Z = -7.33$	$< .001$	Significant difference
Pre-Test vs. Post-Test 3	$Z = -7.67$	$< .001$	Significant difference
Pre-Test vs. Average Post-Test Score	$Z = -7.60$	$< .001$	Significant difference
Pre-Test to Post-Tests 1–3 (Overall)	$\chi^2(3) = 164.97$	$< .001$	Significant variation across assessments

Note. Wilcoxon Signed-Rank Test was used for pairwise comparisons, while the Friedman Test was used to determine differences across repeated measurements.

Multiple tests showed steady growth, suggesting that repeated HOTS–SOLO tasks helped build deeper thinking processes. By having them look at, understand, analyze, and think about the text, the intervention seemed to get students more actively and effectively engaged with what they were reading. The change did not just happen during one test; it lasted through several tests. This shows that the way the kids were taught may have helped them learn in the long run. In addition to being statistically significant, the fact that the intervention led to improvements at all review times suggests that it may have educational value in helping high school students improve their reading skills over time.

The results are in line with those of other studies that have emphasized the importance of teaching reading skills that require higher-order thinking. Binoya (2021) found that using HOTS-based tasks helped elementary school students better understand what they were reading and perform better in school. This was especially true when moving from lower to higher levels of reading ability. Also, Silalahi et al. (2022) found that students taught using HOTS had better literacy and critical thinking skills than those taught using traditional reading methods. The results support findings from Zaim et al. (2021): giving students reading projects that require them to analyze, assess, and review texts helped them think more critically and better understand what they read. In a related study, Zainil and Lena (2020) found that questions designed to trigger higher-order cognitive processes increased students’ interest in the studies and helped them

understand them better. Alimron et al. (2023) also discussed the importance of including opportunities for higher-order thinking in lessons so that students can understand more effectively and learn to think critically.

The data also show that the HOTS–SOLO sample lesson plan may be an effective way to help junior high school students understand what they read. Using planned learning goals and higher-order thinking methods together can help students better understand ideas, read independently, and write more effectively over time, as shown by the steady growth observed during the intervention period.

The improvements could also be due to the way scaffolded brain training works in general. Students may have learned skills that helped them understand on their own as they took on more and more jobs that required them to think, examine, and review. This reading aligns with Vygotsky's (1978) idea that learning starts with guidance and gradually moves to independent practice. Formal higher-order thinking tasks may have helped students get better at making sense of things, making sure they understand, and using their own learning methods, which the study did not do well. Something is wrong with the results that needs to be thought about. The study could not find direct links because it lacked a control group and used only a one-group quasi-experimental design. The method was used only with a small group of 9th graders at one school, so the results might not generalize to all schools. The intervention lasted only four weeks, and there were no follow-up tests to see how well the reading gains held over time. Researchers say that in the future, they should use bigger groups, longer interaction times, and different kinds of tests.

CONCLUSIONS

The study shows that combining HOTS and SOLO reading instruction led to significant improvements in 9th graders' understanding of what they read. Learners got better at reading independently and understood what they were reading more and more as the tests went on. This suggests that structured higher-order thinking tasks may help with useful literacy development. The results show that combining HOTS and SOLO teaching may be an effective way to increase students' interest in reading and to encourage them to use more complex thinking skills while reading. Students seemed to become more independent in understanding, analyzing, and interpreting written materials as they received structured training and increasingly challenging tasks over time.

These findings support both Bloom's updated taxonomy and Vygotsky's sociocultural learning theory. These ideas emphasize the importance of encouraging brain growth and higher-order thinking for learning to be useful. Based on the improvements observed, teaching methods grounded in these theories may help students better understand what they read.

Not having a comparison group in the study meant the results should be

seen only as evidence that the intervention made a big difference. They should not be taken as proof that the intervention caused the change. More research using experimental or mixed-methods techniques is needed to determine how well and for how long HOTS–SOLO-based teaching works across a variety of school settings.

Overall, the study provides evidence that HOTS–SOLO integration may be a promising instructional strategy to support the development of reading comprehension among junior high school learners.

RECOMMENDATIONS

Based on the findings and limitations of the study, the following recommendations are offered:

1. English teachers may consider integrating HOTS–SOLO instructional strategies into reading lessons to encourage deeper cognitive engagement and promote independent reading comprehension among learners.
2. School administrators may support professional development initiatives that strengthen teachers' competencies in designing and implementing higher-order thinking activities aligned with the SOLO Taxonomy and Bloom's revised taxonomy.
3. Reading intervention programs may incorporate HOTS–SOLO principles to provide structured scaffolding for learners who demonstrate instructional or frustration-level reading performance.
4. Future instructional materials may include a wider range of authentic and culturally relevant reading texts to increase student engagement and facilitate the application of higher-order thinking skills in meaningful contexts.
5. Since significant differences were observed according to sex, future studies may investigate the cognitive, motivational, and sociocultural factors that contribute to variations in reading comprehension performance among learners.
6. Future researchers are encouraged to employ experimental designs with comparison groups, longer intervention periods, and larger samples to strengthen causal inference and improve the generalizability of findings.
7. Further studies may incorporate qualitative methods such as classroom observations, interviews, focus group discussions, and reflective journals to provide deeper insight into how students experience HOTS–SOLO-integrated instruction and how these experiences influence reading comprehension development.

8. Longitudinal investigations may be conducted to determine whether improvements associated with HOTS-SOLO instruction are sustained over time and transferred to other academic subjects requiring advanced reading and critical thinking skills.

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