

From Simple to Complex: A SOLO-Based Analysis of Students Research Tasks Responses

DOI: 10.5281/zenodo.14768874

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Abstract

Critical learning plays a pivotal role in students' learning experiences. It allows them to assess situations, tasks, and experiences rigorously and be able to arrive at well-reasoned conclusions. This study examines the extent of student responses in research-related tasks, highlighting the dominance of Unistructural responses, which consist of isolated, unconnected ideas, across different tasks. With a striking dearth of responses at the Multistructural and Relational levels, the findings show that the majority of students exhibited poor knowledge and predominantly operated at the Unistructural level. The analysis specifically shows that while students could recognize and articulate discrete knowledge components, they struggled to connect these ideas or do deeper critical analysis. The absence of responses at high cognitive level, such as Abstract, highlights a significant weakness in students' ability to apply and integrate knowledge in a relational context.

Keywords: *SOLO Taxonomy, students' level of responses in Research tasks, Unistructural, Multistructural, Relational, higher-order thinking skills*

Introduction

Higher-order thinking skills have become an essential aspect of learning. HOTS comprises the abilities of problem-solving, creative, and analytical thinking which are important in cognitive development and academic success in the educative process. According to Schadt (2021), higher-order thinking skills help the cognitive process to go beyond memorizing and basic observation of facts. In this line, teachers prepare activities and tasks that are relevant to real-world challenges to foster these skills compared to traditional mediums of delivering teaching which impedes the students' interest and engagement and hinders them to respond circumstances critically (Saido et al., 2015). In this sense, education must be responsive to the needs of the learners to face real-life situations through integrating the skills in every lesson in the classroom. However, this endeavor is not easy due to the factors that may contribute to the ineffective cause of integrating HOTS in the classroom.

The integration of HOTS in the educative process is not an exemption from the many challenges of education. One of those that adversely affect the aim of learning is the teachers' knowledge in integrating HOTS in the class, the student's background knowledge, and the resources in teaching and learning.

Teachers' knowledge is an important aspect to consider in the delivery of lessons in the classroom. In terms of HOTS, teachers play a significant role in the students' learning since they are the ones who make the commitment and authority in the educative process. Shcheglova et al. (2024) explained that educators who know the utilization of HOTS were able to develop critical and analytical thinking skills of the learners. Although pedagogical knowledge matters, the readiness of the learners and their background knowledge still have a big impact on the attainment of their academic success. The basis for reading comprehension and other cognitive skills is prior knowledge. The development of HOTS requires comprehension and fluency, which highlights that a lack of information may slow down the rate at which HOTS is learned in the classroom (Indriyana & Kuswandono, 2019). Moreover, this is substantiated by the study of Torres (2024). The findings reveal that one of the major challenges in teaching research, which requires analytical skills, is the students' background knowledge. Due to their geographical location, which happens to be in the hinterlands, limited access to educational materials like dictionaries, cell phones, books, and the internet, hindered them to learn other skills. Although clear instructions supplement the learning, having insufficient knowledge still negates the purpose of developing HOTS (Nguyễn & Nguyễn, 2017). This insufficiency not only affects the background knowledge of the learners but also the resources. This means that materials and other educational resources impact the learning of the learners. Having poor, inadequate, and inappropriate resources led to a variety of issues in the educative process such as lack of interest, absenteeism, and poor academic performance among learners (Maffea, 2020). Moreover, Okongo et al. (2015), emphasized that inadequate resources adversely affect the teachers' ability to cater to diverse learners.

In the realm of education, learning has always been the priority. Integrating higher-order thinking skills in the delivery of the lesson helps achieve the goal of education to promote life-long learning. All the possible methods, and frameworks designed in the teaching-learning process are valued and cascaded in the educational landscape to parallel the needs of learners and teachers to attain quality education. In this sense, the practice of developing HOTS is accompanied by a framework called SOLO. Proposed by John Biggs and Kevin Collins in 1982, the Structure of the Observed Learning Outcome is a framework for educational taxonomy that allows teachers to evaluate students' answers to specific tasks by classifying learning outcomes according to their complexity (Snazlan, 2017). This framework describes the level of students' responses to a certain task namely, prestructural, unistructural, multistructural, relational, and extended abstract.

In prestructural, students give incorrect answers based on the given question or task. In this initial stage, they do not have any idea or develop an understanding of a particular topic. On the other hand, unistructural level describes how students know very little about the subject; they could just be aware of one specific detail about it. Moreover, if students know pieces of information relevant to the task, they belong to the multistructural level. This means that students from unistructural learn few things about the subject, however, do not know how to relate this information to each other. In relating ideas to the other, the relational level is an appropriate description for this skill. In this stage, the students move to the next level of higher-order thinking skills. This time, they can link ideas around a specific topic. This skill becomes more complex in the extended abstract since students do not just explain the relationship between ideas but can generalize, hypothesize, and create something out of the box (Drew, 2024).

The application of HOTS and SOLO in the educational landscape prepares teachers and learners for an opportunity that yields analytical and responsive individuals in the future. In this sense, the purpose of the study is to assess the grade 12 students' responses to Practical Research 1 tasks using the SOLO framework. Moreover, this study emerged due to the lack of literature that supports the SOLO framework as employed in research subjects. Thus, the present study concentrates on the research scenarios as tasks including literature review, research design, data gathering method, and reporting results to elicit the students' responses through statements and question formulation. Thus, the result of this study will be the basis for strategy development that will aid teachers and students to learn at a higher level. This study aimed to answer the following questions.

1. Based on the SOLO framework, what is the level of grade 12 students' responses in the following tasks:
 - 1.1. Task 1
 - 1.2. Task 2
 - 1.3. Task 3
 - 1.4. Task 4
2. How do students respond to the different tasks in terms of:
 - 2.1. Statement
 - 2.2. Question formulation
3. Based on the result of the study, what recommendation can be made?

Methodology

In this study, the researcher employed descriptive qualitative research since the nature of the inquiry is to analyze the verbatim responses from the textual tasks associated with Practical Research 1. This study utilized a purposive sampling technique where all thirty-nine grade 12 students were chosen to participate. Anent, there were criteria strictly followed by the researcher such as a) participants/respondents must be officially enrolled in Sto. Niño High School, b) participants/respondents must have 85% attendance in the 1st semester in Practical Research 1., and c) the participation is voluntary through informed consent. In terms of the instrument of the study, validity-wise, the researcher made four research tasks related to qualitative research. These tasks were reviewed by three experts in the field. Anent to the tasks, some questions were evaluated to determine if they pertained to a particular level of SOLO they were supposed to assess. Moreover, the SOLO framework was used to describe the respondents' answers to the different tasks, and frequency and percentage distribution were also utilized to quantify their responses. Thus, three qualified resource speakers about the SOLO framework assessed the responses of the students. This was to ensure that the researcher's interpretation was not biased and objective.

This research strictly followed the tripartite steps which include the pre-data gathering, during, and post-data gathering.

Before the study was administered, the researcher submitted a proposal to the school's board of reviewers to ensure that it did not contain elements that were detrimental or could cause harm, especially to the respondents. Once the board approved the proposal, the researchers invited the respondents to an orientation highlighting the study's nature and significance.

During the commencement of the study, the researcher distributed the research tasks related to qualitative research or Practical Research 1 to the respondents.

After the administration of the data, the researcher categorized the responses of the respondents and then validated them by the three qualified people who were the Division resource speakers in the SOLO framework Training.

Ethical Consideration

The research was carried out by the researcher with ethics and proper communication. After being approved by the schools' review board, the researcher invited the respondents through an orientation, and important agenda were completely discussed. This included the nature and significance of the study. Furthermore, the researcher emphasized the content of the informed consent and stressed that participation in the study is purely voluntary and that they can withdraw at any time they wish to. In terms of the privacy of the respondents, the research made sure to make their identity remain unknown and codes were utilized to protect their privacy. Data-wise, the researcher made clear to the respondents that the data shall be kept with utmost confidentiality and for research purposes only as anchored in the Implementing Rules and Regulations (IRR) of the Data Privacy Act of 2012 (RA 10173).

Findings

This section reveals the grade 12 students' level of responses in terms of the given related research tasks and the category of their responses using the SOLO framework introduced by John Biggs and Kevin Collins in 1982.

Task 1. Literature Review

Jellum is a graduating college student at one of the prestigious universities in the Philippines. One of the partial requirements before finally graduating is to write a thesis and defend it. During his pre-oral defense, one of the positive comments was the way he synthesized his literature. When asked by the panel about the procedures he made for his literature review, he said that he identified first the problem of the study. Through this, variables were established too and were individually linked to other existing literature to provide the research gap of the study. Moreover, related studies were included to emphasize whether the findings and results support or contradict the result of the present study. With this, he was

Questions

1. What can you say about the procedures made by Jellum in synthesizing literature and how you do it in your research?
2. What question can you create based on the scenario above?

Table 1 Statements response level to Task 1 using the SOLO framework

Table 1 shows that 89.74% of the total respondents' statement responses pertain to the Unistructural level which is viewed as the highest response among other SOLO levels. Surprisingly, the levels of Multistructural and Relational got the lowest responses as demonstrated by 5.13%.

SOLO Taxonomy	Frequency	Percentage %
Pre-structural	0	0
Unistructural	35	89.74
Multistructural	2	5.13
Relational	2	5.13
Extended abstract	0	0
Total	39	100

Table 2 Questions response level to Task 1 using the SOLO framework

The table shows that the Unistructural level has the highest responses as evidenced by 53.85% while the lowest responses pertain to the Relational level as demonstrated by 5.13%.

SOLO Taxonomy	Frequency	Percentage %
Pre-structural	0	0
Unistructural	21	3.85
Multistructural	16	41.02
Relational	2	5.13
Extended abstract	0	0
Total	39	100

Task 2. Research Design

Sharla was a bit confused about the research design she was going to use in her thesis. Upon thorough review, she has finally come up with a design that fits the complexity of her research. Then, she used an explanatory sequential mixed method which means both quantitative and qualitative are used to treat the data. On the quantitative side, Sharla employed a correlation to identify relationships between instructional materials in English Language Teaching and the teachers' educational attainment. On the other hand, in the qualitative sense, she used thematic analysis to generate codes and themes and define these themes accordingly.

Questions

1. What makes the explanatory sequential mixed method a bit complicated and what makes it different from other research designs?
2. What question can you create based on the scenario above?

Table 3 Statements response level to Task 2 using the SOLO framework

The table shows the respondents' SOLO level in responding to Task 2. Based on the data, the highest responses fall under the level of Unistructural which is demonstrated by the percentage of 66.67 while the lowest response pertains to Relational as evidenced by 7.69%.

SOLO Taxonomy	Frequency	Percentage %
Pre-structural	0	0
Unistructural	26	66.67
Multistructural	10	25.64
Relational	3	7.69
Extended abstract	0	0
Total	39	100

Table 4 Questions response level to Task 2 using the SOLO framework

The table reveals that the respondents got the highest response at the Unistructural level in terms of question formulation in response to Task 2 as evidenced by 79.62%. On the other hand, as demonstrated by 5.13%, respondents got the lowest response at the Relational level.

SOLO Taxonomy	Frequency	Percentage %
Pre-structural	0	0
Unistructural	30	76.92
Multistructural	7	17.95
Relational	2	5.13
Extended abstract	0	0
Total	39	100

Task 3. Data Gathering Methods

Andrew is already in his gathering data stage in research. As he collected data, he used multiple methods such as surveys, focused group discussions, observations, and note-taking. The survey was utilized to understand the whole population using a sample. Moreover, focused group discussions were made to support the results from the data. Andrew wanted to understand how the environment influences the participants' answers, so he used observation. Upon observation, he was very particular about the words and sentences in the participants' responses and was very cautious to miss little words, fillers, and other gestures made by the participants.

Questions

1. Why do you think Andrew used multiple methods in data gathering and how did these methods help him achieve credibility of the data?
2. What question can you create based on the scenario above?

Table 5 Statements response level to Task 3 using the SOLO framework

Table 5 shows that respondents' highest level of response in Task 3 pertains to Unistructural as evidenced by 74.36%. Surprisingly, the lowest responses pertain to the levels of Multistructural and Relational which is demonstrated by 12.82 %.

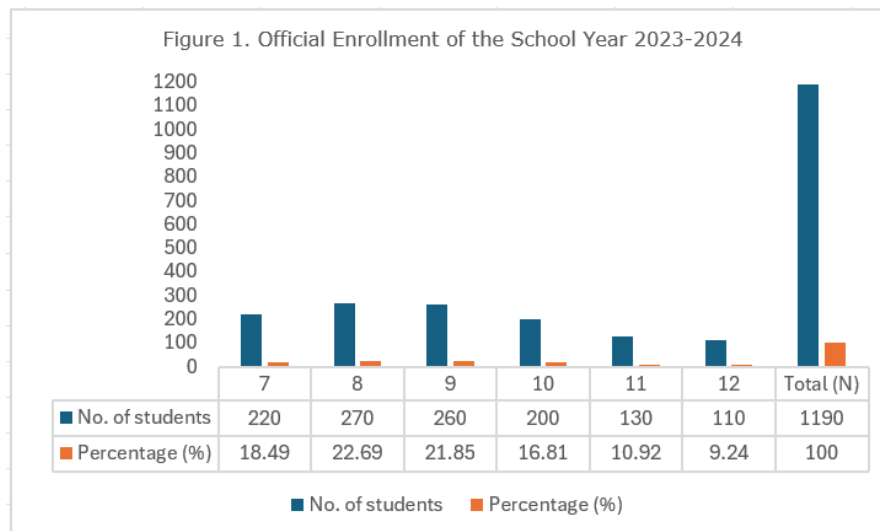
SOLO Taxonomy	Frequency	Percentage %
Pre-structural	0	0
Unistructural	29	74.36
Multistructural	5	12.82
Relational	5	12.82
Extended abstract	0	0
Total	39	100

Table 6 Questions response level to Task 3 using the SOLO framework

Table 6 presents that most of the responses of the respondents fall under the level of Unistructural as demonstrated by 66.67%. However, the lowest responses pertain to the Relational which is evidenced by 10.26%.

SOLO Taxonomy	Frequency	Percentage %
Pre-structural	0	0
Unistructural	26	66.67
Multistructural	9	23.08
Relational	4	10.26
Extended abstract	0	0
Total	39	100

Task 4. Reporting Results



Questions

1. Report the result of the survey. How will you explain the data provided?
2. What question can you create based on the scenario above?

Table 7 Statements response level to Task 4 using the SOLO framework

In Figure 7, it is evident that most of the statement responses of the respondents pertain to the Unistructural level as demonstrated by 76.92% while 2.56% represented the level Relational.

SOLO Taxonomy	Frequency	Percentage %
Pre-structural	0	0
Unistructural	30	76.92
Multistructural	8	20.51
Relational	1	2.56
Extended abstract	0	0
Total	39	100

Table 8 Questions response level to Task 4 using the SOLO framework

Figure 8 reveals that the highest response of the respondents in terms of question formulation pertains to the Unistructural level which is evidenced by 87.18%. On the other hand, the lowest responses fall under the level of Relational as demonstrated by 5.13%

SOLO Taxonomy	Frequency	Percentage %
Pre-structural	0	0
Unistructural	34	87.18
Multistructural	3	7.69
Relational	2	5.13
Extended abstract	0	0
Total	39	100

Discussion

Based on the findings, the tables reveal different response levels in research tasks using the SOLO framework.

In task 1 figure 1, respondents had the highest response level in the Unistructural and lowest responses in the Multistructural and Relational levels in terms of statement responses. In Unistructural, the student's comprehension is restricted to discrete discipline information, and they can recognize individual components of knowledge (Structural Learning, 2022). This idea is supported by the respondents' responses in answering the first question in task 1. "I like how Jellum worked on his literature, and I am planning to do the same in my would-be study", and "Jellum's way is good, and I will do the same in my research". These responses were almost identical where students manifested only a single idea in answering the question. On the other hand, few responses pertained to the Multistructural and Relational level. In Multistructural, the ideas of the responses were varied. This means that students gave different views, not only one idea in answering the question (Ip, 2024). "I think that Jellum's procedures were tedious. However, the procedures were so easy for Him. I am planning to start learning his procedures too so I can make my literature review as good as his. Also, I will read more books". This answer presents varied ideas that are not connected which is an opposite to the relational level. Students can make connections with his/her ideas on a deeper level (TanzeelaBashir, 2022). As supported by one of the responses, "I was amazed by how Jellum worked on his literature review. He must have gone training to know things like that. In my case, I would do the same as he did. It was systematic and I want my literature to be that way too. I could ask my cousin to help since she has a full-fledged master's degree". According to her, she made a literature review for her research before

so I know she can help me". This answer revealed that the respondent's responses were able to make connections based on his/her experiences. In general, question 1 under Task 1 is designed to assess the relational-level responses of the respondents in the question. However, it turned out that most of the students' responses pertained to the Unistructural level and lowest in the Multistructural and Relational level. Similarly, figure 2 under Task 1 shows that most of the responses fall under the Unistructural level in terms of question formulation. This is substantiated by the common responses of the respondents: *"How does Jellum do his literature review?"*, and *"What is the first thing Jellum did in his literature review?"* These responses are evident in the Unistructural level since the responses focus only to a single idea. In contrast, the lowest responses pertain to the Relational level where two of the respondents moved to a higher level of thinking, making questions that led to association and connection to previously learned knowledge, as represented by a question, *"What experiences do you have in doing literature and what makes it similar or different from the procedures of Jellum?"*.

Figure 3 under Task 2 shows that responses pertain to the Unistructural level and the lowest to the Relational level. Question 1 is supposed to measure the relational level of the student's responses, but it turned out that most of the responses pertain to the Unistructural level. This emphasized that in the statement responses, they only provided a common, single idea as expressed by the following statements: *"It's complicated because we use both quantitative and qualitative methods"*, and *"Other designs use only one method. Here, two methods are used"*, *"It's complicated since two methods have different approaches"*. On the opposite side, only three responses pertain to the relational level as expressed, *"I think that it is difficult since two methods are combined already. Each method uses a corresponding analysis and according to the book I read, having mixed methods can dig deeper into a certain problem since the results are being supported by the statements of the participants."*

Figure 4 refers to the question formulation under Task 2. This shows that in question responses, the highest percentage pertained to the Unistructural level where it is evident in their responses: *"What analysis framework did Sharla use in qualitative data?"*, *"To identify the relationship of the variables, what method under quantitative method is used by Sharla?"*, *"Due to the complexity of Sharlas' research, what method did she use?"* These question responses describe how respondents show a specific idea and do not know much about the subject.

Figure 5, under Task 3-data gathering methods, shows that most of the responses pertain to the Unistructural level while the lowest responses fell under the level of Multistructural and Relational in the statement formulation. At the level of Unistructural, the respondents provided only a single idea about the question. *"Because Andrew thought it could help his study."*, *"Andrew believed that through a variety of methods, he could make his study comprehensive."* *"He has considerations about why he chose multiple methods in data gathering."* These exposed that the response level of the grade 12 students in the data gathering method task did not go beyond a single idea, instead focusing only on one answer to the question.

Figure 6 shows that in question formulation, most of the responses pertain to the Unistructural level answering question number 2, students' answers displayed a common single thought or idea. *"What method is included in the multiple methods used by Andrew?"*, *"Since Andrew wanted to understand how the environment influenced the participants' responses, what method did he use?"*, and *"What was the use of survey?"* These responses pertain to the Unistructural level since they conveyed a single point. On the other hand, the lowest responses fell under the level of relational where respondents' answers were able to show a relationship of ideas. This result is substantiated by their common responses. *"Why do you think Andrew used multiple methods in collecting data? and how will you apply it in your research in the future?"*, and *"Do you find Andrew's methods in collecting data comprehensive? And how will you apply it in your future research?"* These responses clearly show that the ideas presented by the respondents were making connections between ideas.

Meanwhile, figure 7 shows that in task 4, respondents' highest responses pertained to the Unistructural level, and the lowest responses belonged to the Relational level in terms of statement responses.

The highest responses of respondents are manifested by common or relative answers on the first question as expressed, *"Grade 8 has the highest number of students"*, *"the total population of the students from grade 7 to 12 is 1990"*, *"Grade 12 has the lowest number of students"*. This means that the responses of the respondents displayed only a single idea that can be answered to the question. On the other hand, the lowest responses pertained to the relational level are substantiated by these responses. *"I just thought that grade 8 has the highest number of populations for some reason. It could be that there are transferees from other schools who are eligible for grade 8, or maybe because in the previous school year, grade 7 students had the greatest number of students so obviously, this year, most or all grades 7 students moved up to grade 8 in the same school in the school year 2023-2024."*, *"the number of students in grade 11 and 12 is lesser compared to the number of students in grade 7, 8, 9, and 10."*

Maybe students are transferring because they want to study at other schools that have different programs in senior high school". These responses demonstrated that the ideas of the respondents are connected or associated with other ideas to establish a connection. This means that the respondents thought outside the box and did not only state what was evident in the task.

In Figure 8, under task 4 which is the question formulation, most responses pertained to the Unistructural level, and the lowest pertained to the Relational level.

Based on the responses of the respondents at the Unistructural level, ideas were given in a single and acceptable answer. These ideas are represented by their common responses: "What is the grade level that has the lowest number of students?", "What is the grade level that has the highest number of students?", "What is the total population of the students in the school year 2023-2024?" These questions only show a single idea as a response to the task. On the other hand, at the Relational level, responses pertain to a different or complex level of giving responses. As expressed by the respondents, "What do you think are the reasons why grades 11 and 12 have fewer students compared to other grade levels and how can the school increase the number of enrollees in senior high school?", "What do you think is the role of the teachers in the school and how can it affect the enrollment of the school?" These questions show that students' responses in terms of question formulation demonstrated a complex way of responding to the task by providing ideas and linking these ideas to one another to produce connections and generalizations.

Conclusion

This study shows that most students' responses to the different research tasks primarily remain at the Unistructural level, demonstrating minimal interaction with the content marked by singular, disconnected ideas. On the other hand, responses at the Multistructural and Relational levels are significantly less common, indicating a requirement for improved critical thinking and stronger relationships between concepts in student learning, while no response at the Pre-structural and Abstract levels. Thus, the findings will lead to the development of a strategy or strategies in teaching research that shall parallel most of the competencies represented in the research tasks such as literature review, data gathering methods, research design, and reporting results.

Furthermore, the study suggests that DepEd should provide training to teachers relative to higher-order thinking skills and the Structure of Observed Learning Outcomes (SOLO) framework for better understanding and implementation in their respective fields.

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