

# Solo Taxonomy as an Assessment Tool in Improving the Critical Thinking Skill of TLE – Drafting Learners

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## Abstract

The research was conducted to determine the effectiveness of SOLO Taxonomy Assessment to Improve the Critical Thinking Skills of Grade 9 TLE – Drafting Learners. This study utilized a quasi – experimental research design which implement SOLO taxonomy assessment to forty – four (44) drafting students during their 2nd grading period of S.Y 2024 – 2025. Pre – test and post – test was administered to test the significant increase in their critical thinking skills. This study is limited in the use of SOLO Taxonomy as an assessment in learners’ critical thinking skills focused on analyzing, synthesizing, and evaluating. This research paved the way to improve students critical thinking skills by exposing the learners to SOLO Taxonomy based questions. The results revealed that students had a significant increase in their level of critical thinking skills when SOLO taxonomy as an assessment was used. Moreover, the highest increase was seen in analyzing, followed by evaluating, while synthesizing shows the lowest, but still significant. Furthermore, if the students were exposed to SOLO taxonomy assessment it enhances the critical thinking skills of the student.

Keywords: SOLO Taxonomy, Assessment, Critical Thinking

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## 1. The problem and its background

### 1.1. Introduction

Technology and Livelihood Education (TLE) is a subject in the Philippine Secondary Education which teaches students to become skilled and globally competent for the job they want in the future. TLE teachers teach students to become knowledgeable and equipped in the field.

According to Marquez (2017), one of the most prominent effects of globalization is the demand for skilled humans. Despite the demand of the globalized world, the Filipino children should not only be sent to school to become skilled that would make them competent, but more importantly they should be trained to become critical thinkers.

According to Bloom et. al (1956), as cited by Kennedy et. al (1991), that critical thinking can be classified into three categories, this involves analyzing, synthesizing and evaluating. According to Momen et. al 2022, at the analyzing stage of learning, the learner can explain the effectiveness of the solving strategy. A student can combine steps in a process in a novel and beneficial way when they are learning at the synthesis level. The learner has a wide range of options for solving the problem at the evaluation stage of learning.

Structured of Observed Learning Outcome (SOLO) provides a well-organized framework that students can utilize to develop their knowledge and reasoning (Structural Learners 2021). SOLO taxonomy is a crucial framework for comprehending and honing critical thinking skills. It enhances students' ability to analyze, synthesize, evaluate, and apply knowledge in complex ways. (Ip, L. 2024).

With this, the Philippines has the capacity to prosper alongside its progressive Asian neighbors. However, this dream can only come true if the next Filipino generation learns to think critically. (Felix, N. 2023).

## *1.2. Background of Study*

In the Philippine Secondary Education Curriculum, students are taught four areas under the subject of Technology and Livelihood Education (TLE): information and communication technology, industrial arts, home economics, and agri-fishery. Providing students the skills and information, they need to grow into responsible adults who can support the development of their communities is the goal of TLE.

As Department of Education aims to equip Filipino students with high-quality education and the skills, they need to meet the challenges of the 21st century. (DepEd Order No. 21 s, 2019). Critical thinking is the number two among the top ten 21st century skills that the students should have in 2020 according to the World Economic Forum survey in 2016 (World Economic Forum, 2016). According to Stauffer, (2021) critical thinking is one of the four "C's" needed by the student to succeed in school.

According to Brazel (2020), enhancing pupils' literacy and giving them the ability to evaluate and analyze information are vital. Despite the fact that 97.95 percent of Filipinos are literate, the nation has not changed in recent decades to match the demands of the modern world in terms of information processing. Educational institutions must change their teaching methods to enable students to evaluate, interpret, and find reliable sources for their own work in order to counteract this trend.

As a means of guiding beliefs and actions, critical thinking is the intellectually rigorous process of actively and skillfully conceiving, applying, analyzing, synthesizing, and/or evaluating knowledge generated by or obtained from observation, experience, reflection, reasoning, or communication. (University of Louisville, 2012). In the Department of Education, most of the educators used Revised Bloom's by Anderson and Krathwohl (2001) as their guide in the formulation of the assessment task and lesson development (DepEd Order No. 8 s, 2015). However, Drew C. (2022), said that the SOLO taxonomy is a more practical framework than Bloom's taxonomy due to its focus on observable outcomes rather than internal cognitive processes. He also said that the verbs in SOLO taxonomy are all observable, making them ideal for assessments.

SOLO is a framework craft by John Biggs and Kevin Collis that classifies levels of understanding as pre-structural, uni-structural, multi-structural, relational, and extended abstract. According to Damopolii, (2020) cited by Dumaraos, (2022), Biggs and Collis (1982) created the Solo Taxonomy (Structure of Observed Learning Outcomes), a methodical approach to how students' comprehension progresses from simple to complex as they study various tasks or subjects. The SOLO Taxonomy offers a methodical approach to gaining profound understanding and can be utilized to improve the caliber of instruction in the classroom.

According to Mukuka, A. et. Al., (2020), is one essential assessment tool for teaching and understanding mathematics is solo taxonomy. It reveals the area of the subject that the student has difficulties with and gives a hint of the area that needs remediation. SOLO taxonomy is one of the models that can be considered in developing assessments to analyze students' responses in what level of SOLO taxonomy the learning outcome falls. SOLO taxonomy combined with authentic assessment can be a powerful tool for evaluating students learning competency. (Mindayani et al., 2020).

This study aims to bridge the gap between technology and livelihood education by using SOLO taxonomy as an assessment to improve the critical thinking of the learners. This study also wants to find out if SOLO taxonomy is effective to use in Technology and Livelihood Education in improving critical thinking since researches are applied to subjects' mathematics and science.

### *1.3. Objective of the study*

Specifically, the study aimed to determine the effectiveness of SOLO taxonomy assessment to improve the critical thinking skills of the respondents. The study also seeks to determine if there is a significant difference between the pre – test and post – test scores of the respondents before and after the implementation of SOLO taxonomy assessment.

## **2. Literature Review**

### **SOLO Taxonomy**

Somani (2022) states that Kevin Collis and John Biggs developed the Structure of Observed Learning Outcomes in 1982 as a substitute for Bloom's taxonomy. This framework characterizes the stage of learning in developing complexity in students' knowledge of subjects or performance assignments. SOLO assesses the cognitive learning results or knowledge of thinking that may be applied across many activities and several disciplines. The SOLO model also reflects the student learning in phases of rising complexity.

### **Assessment**

Based on the DepEd Order No. 8 s, 2015, assessment is a process that is used to monitor students' development of 21st century skills and their progress toward learning standards. It also encourages students to reflect on their own learning and take on their own responsibility for it. Moreover, it serves as a foundation for profiling students' performance in relation to the educational competencies and criteria of the curriculum.

According to the studies of Prasanthi and Vijetha Inti (2019) and Messersmith (2015), cited by Matanguihan, J.R.E (2024), Assessment is the key component of all education systems and play a major role in a student's learning journey. Assessment is also a bridge that connects teaching and learning which makes it an integral aspect of teaching and learning cycle. Measurement of student learning through assessment is important because it provides useful feedback to instructors and students about the extent to which students successfully meet the course learning objectives.

### **Critical Thinking**

According to Ismail (2018), critical thinking is a skill that is very important in the 21st century. Such skills are an integral part of students who are willing to live the harder life of the 21st century and work in the environment. Why is it important to learn critical thinking? Among the other reasons, there are several: To solve problems and be an advantage in your career, critical thinking is an expertise which is necessary for every job. In the 21st century, critical thinking is important because it is an era of information and technology. You should react quickly and adequately to changes, so that you can adapt intellectually, break data down and coordinate various sources to solve issues.

## **3. Methodology**

This study employed a quasi-experimental research design. Quasi-experimental research is a methodological approach designed to ascertain the causal relationship between two variables: the independent variable and the dependent variable. The study employed total enumeration of respondents. This study was focused on Grade 9 students taking TLE – Drafting consisting of forty – four (44) learners at Dagatan

National High School in Brgy. Dagatan, Dolores, Quezon. The respondents are only forty – four (44) because the researcher is the only one teaching drafting lessons to Grade 9 learners and only handles one section.

#### 4. Findings and Discussion

Table 1. Pre – test scores of the students critical thinking

Analyze	Analyze N	%	Synthesize	%	Evaluate	%
90 and above	5	11.36	2	4.55	3	6.82
85 to 89	6	13.64	8	18.18	7	15.91
80 to 84	16	36.36	20	45.45	19	43.18
75 to 79	9	20.45	5	11.36	7	15.91
below 75	8	18.18	9	20.45	8	18.18
total	44	100	44	100	44	100

Legend: 90 and above Highly Mastered/Extended Abstract, 85-89 Mastered/Relational, 80-84 Nearly Mastered/Multi-structural, 75-79 Least Mastered/Uni-structural, below 75 No Mastery/Pre-structural.

Table 1 shows the distribution of scores for Analyze, Synthesize, and Evaluate on to critical thinking skills in pre - assessment. A large quantity of students (36.36%) scored in the 80-84 range, indicating that most of the students achieved a Nearly Mastered performance in analytical skills. In addition, majority of the students also scored in the 80-84 range, meaning the students achieved a Nearly Mastered performance in the synthesis skills. However, in evaluation skills the learners also achieved 80-84 range, showing Nearly Mastered skills. Across all 3 skill areas, most of the students scored between 80-84 range, reflecting Nearly Mastered competency. This result shows that most of the students falls under the multi – structural level of thinking in SOLO taxonomy. This result is supported by the study of Damopolii, I. et al. (2020) stated that prior to the implementation of learning, the respondents critical thinking skill falls under multi – structural level. This implies that the students have several ideas, but these ideas are disjoint or not connected to each other according to Mukuka, A., Balimuttajjo, S., & Mutarutinya, V. (2020).

Table 2. Post – Test Scores of the students critical thinking

Analyze	Analyze N	%	Synthesize	%	Evaluate	%
90 and above	22	50.00	7	15.91	12	27.27
85 to 89	9	20.45	9	20.45	13	29.55
80 to 84	9	20.45	20	45.45	10	22.73
75 to 79	1	2.27	6	13.64	6	13.64
below 75	3	6.82	2	4.55	3	6.82
total	44	100	44	100	44	100

Legend: 90 and above Highly Mastered/Extended Abstract, 85-89 Mastered/Relational, 80-84 Nearly Mastered/Multi-structural, 75-79 Least Mastered/Uni-structural, below 75 No Mastery/Pre-structural.

Table 2 shows that fifty percent (50%) of the students scored 90 and above in analyzing, showing strong analytical abilities or Highly Mastered/Extended Abstract. This outcome is corroborated by the research of Halpern (2014), which states that different dimensions of critical thinking develop at varying rates. Higher scores in analysis are common as students often practice analytical thinking more frequently than synthesis or evaluation. The table also shows that forty-five-point forty-five percent (45.45%) of the students score 80 to 84 range or Nearly Mastered/Multi-structural. This also indicates a relative increase in synthesis skills compared to the pre-test scores of the students. Ennis (2018) discusses a need to emphasize synthesis, as it involves complex thinking processes requiring creativity, often less nurtured in traditional

curricula. In addition, the table shows twenty-nine-point fifty-five percent (29.55%) of students scored in the 85 to 89 range or Mastered/Relational. Twenty-seven-point twenty-seven percent (27.27%) achieved 90 and above or Highly Mastered/Extended Abstract showing good performance in evaluative skills. According to Facione (2011), students tend to score higher in evaluation due to structured education system focusing on decision-making and judgement skills, similar to the evaluation scores observed here. However, according to Moneva, J.C. et. Al. (2020), lacking critical thinking is also one of the reasons to affect the pupils' performance and most of the students' problem lies in the comprehension of the problem. In addition, according to Mateos & Sole (2025), producing written synthesis is difficult even for university students.

Table 3. Significant difference between pre – test and post – test scores of students critical thinking in terms of analyze, synthesize, and evaluate

	Paired Differences				t	df	Sig. (2-tailed)
	Pretest		Posttest				
	Mean	SD	Mean	SD			
<b>Analyze</b>	79.73	7.39	83.68	6.08	-7.183	43	0.000
<b>Synthesize</b>	80.64	6.71	85.82	7.97	-2.777	43	0.008
<b>Evaluate</b>	80.77	5.68	87.86	6.12	-3.559	43	0.001

Table 3 presents the test of difference in critical thinking skills before and after using the SOLO taxonomy assessment. It can be seen from the table that in terms of analyzing a mean of 79.73 during the pre – test and mean of 83.68 in the post – test revealed that a significant difference is found with a t – value of -7.183 and 0.00 level of significance indicates that the use SOLO taxonomy assessment greatly improves student's critical thinking skills in terms of analyzing. This is supported by Arceo, K.M.M. (2024), states that after the implementation of SOLO taxonomy, there is a substantial improvement in students' critical thinking. This implies that exposing the students to SOLO taxonomy assessment greatly improves the analyzation of the students. In addition to this, in terms of synthesizing a mean of 80.64 during the pre – test and mean of 85.82 in the post test revealed that a significant difference is found with a t – value of -2.777 and 0.008 level of significance indicates that the use of SOLO taxonomy assessment slightly improves student's critical thinking skills in terms of synthesizing. However, Mateos & Sole (2025), states that producing synthesis is difficult even for university students. This result implies that synthesizing is hard, especially to high school students. Moreover, in terms of evaluating, the students got a mean of 80.77 during the pre – test and mean of 87.86 in the post – test revealed that a significant difference is also found with a t – value of -3.559 and 0.001 level of significance indicates that SOLO taxonomy assessment also greatly improves student's critical thinking skills in term of evaluating. These findings are supported by the studies of Halpern (2014) and Facione (2011) state that critical thinking exercises can significantly boost cognitive skills across these domains. The respondents were exposed within 8 weeks during the second quarter of the school year 2024-2025. The SOLO taxonomy-based question was implemented during the discussion and evaluation of the lessons.

All three (3) categories (Analyze, Synthesize, Evaluate) show significant improvements in post – test scores compared to pre – test scores, demonstrating the effectiveness of the SOLO Taxonomy Assessment Tool in enhancing the critical thinking skills of the students. The highest improvement is seen in Analyzing, followed by Evaluating, while Synthesizing shows the lowest, though still significant.

#### 4.1 Conclusions

In light of the findings of the study, the hypothesis that there is no significant difference between pre – test and post – test scores of students critical thinking in terms of analyzing, synthesizing, and evaluate is rejected.

#### 4.2 Recommendations

In light of the findings of this study, teachers and researchers can consider the following recommendations were conceived:

1. Teachers that are handling the subject that SOLO Taxonomy Assessment is never been applied can use this kind of assessment to improve the critical thinking skills of the students.
2. Teachers can also modify the questions to enhance the synthesizing and evaluation skills of the students, where these two Critical Thinking Skills garnered the lowest result in this study.
3. TLE teachers can also apply SOLO taxonomy assessment in their field of specialization to improve the critical thinking skills of the student.

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