
SOLO TAXONOMY AS AN ASSESSMENT TOOLS FOR COMPLEX ENGINEERING

Badrul Nizam Ismail & Dr. Hazrina Ahmad

In general, complex engineering can be defined as ill or poor-defined problem. Ill-defined problem is a situation which the input, process and output of problem-solving task is not clear. On the contrary, well-defined problem has clear input, process, and output. Engineering Programme Accreditation Standard (2020) explicitly mention the requirement for the implementation of complex engineering via complex problem solving and complex engineering activities. In addition, this standard also provides a list of attributes that needs to be fulfilled by the designed assessment, to qualify it as a complex question. In simple words, complex engineering is considered as an ill-defined problem that comply with the required attributes provided in the standard.

One of the challenges in evaluating complex problem and complex activities assessment is preparing rubric that can truly assess the complex criteria. Bloom's taxonomy had been widely used since the implementation of

>>> Outcome Based Education (OBE) in engineering program, but this taxonomy is designed to cater for different level of difficulty, not different level of complexity. Therefore, another taxonomy is proposed, which is the Structure of Observed Learning Outcomes (SOLO) Taxonomy.

SOLO Taxonomy was first proposed by John B. Biggs and Kevin F. Collis in 1982, in a book entitled "Evaluating the Quality of Learning: The SOLO Taxonomy". In SOLO Taxonomy, there are five levels of complexity, which are prestructural, unistructural, multistructural, relational and extended abstracts. The level of complexity increases from prestructural to extended abstracts. The following paragraph will define each level, together with the explanation using LEGO as an analogy.

Prestructural. This is the lowest level for SOLO Taxonomy. The students are not able to understand and had no idea on the task that needs to be completed. They may be able to provide answer, but it is wrong. Using LEGO as an analogy, students at this level do not know what LEGO is.

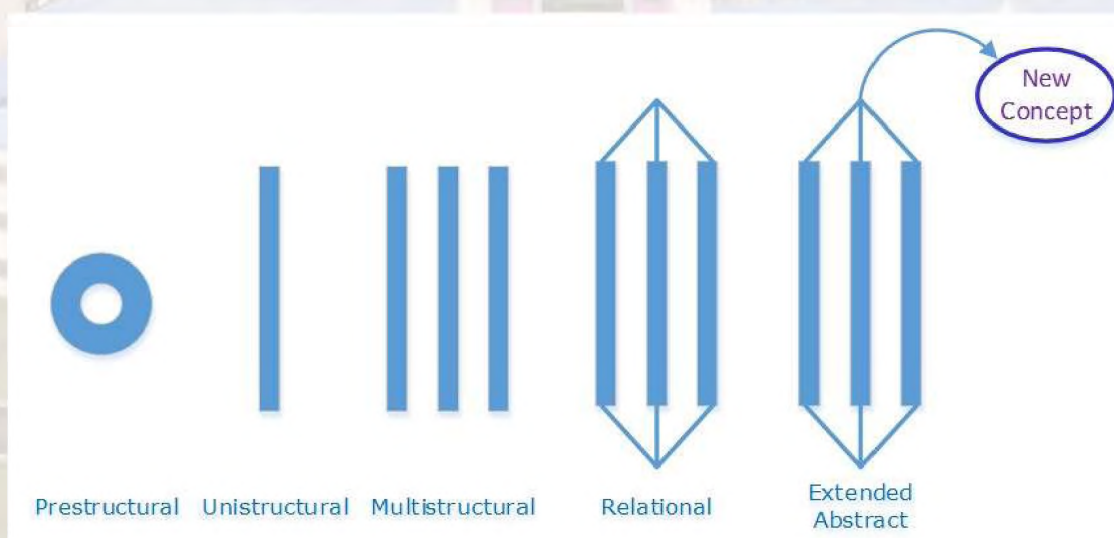
Unistructural. For this level, students are able to understand only one aspect of the task, but do not comprehend other necessary aspects of the task. It is like having only one piece of LEGO, it cannot function by itself, without the presence of other pieces.

Multistructural. Students manage to capture more than one part of the task, but still do not manage to relate between those tasks. It is analogous of having a pile of LEGO bricks, but nothing is done with the bricks. For this stage, it can be internally separated into several sub-level, as the term multi means more than one. For example, sub-level for two, three and four parts.

Relational. At this level, students manage to establish relation between all required characteristics of the task and integrate them into one structure. It is comparable to ability of constructing a complete object using the LEGO components. However, the blueprint of the object is already given by LEGO manufacturer.

Extended Abstract. For the highest level of complexity, students are able to propose or create a new domain, after managing to integrate all parts in the previous level. It is equivalent to the previous level, however, instead of assembling a complete object based on the given instruction provided by the blueprint, they are creating a new object.

The levels of complexity in SOLO Taxonomy are often represented by symbols as shown in the figure below. The figure is self-explained; unistructural is represented by one bar, multistructural is denoted by more than one bar, relational with lines connecting all bars together while extended abstract is a way forward with a new domain (concept) emerging from the relational level



As a conclusion, SOLO Taxonomy is a suitable tool for assessment of complex engineering task, because it is developed by considering the increasing level of complexity. Bloom's taxonomy can still be used as objectives of the task or criteria that needs to be fulfilled by student to complete the task.

Reference: SOLO taxonomy explained using LEGO. <https://youtu.be/uDXXV-mCLPg>