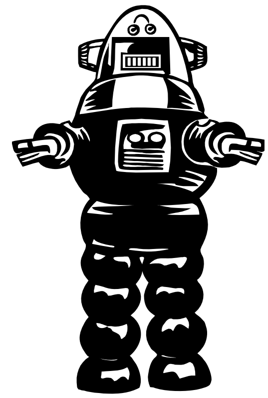
A Primer on Learning Outcomes and the SOLO Taxonomy



What is a Learning Outcome?

Learning outcomes are statements that indicate what students will know, value or be able to do by the end of the course. They are the **assessable ends** of education, written from the students' perspective, focused on what students can expect to achieve if they have learned successfully. In order to be assessable, they must specify things that can be observed, that are public, and not activities or states that are internal to students' minds.

Every learning outcome follows a **stem**, such as:

On successful completion of this course, students will be able to:

After the stem, you write a list of your learning outcomes, each of which begins with an **active verb** or phrase that tells people what sort of public, observable activity will be expected of them.

Finally, you have the **object** of that verb – a concept/idea, skill, attitude or value. There are three domains of knowledge from which you can draw these objects:

1. **Cognitive –** Concepts, ideas, beliefs, and facts. If you can say, "I believe that X", then you're dealing with the cognitive domain. Cognitive knowledge is "knowing *that*" and "knowing *about*", sometimes "knowing *why*". It is also called "declarative" or "propositional" knowledge.

2. **Performative –** Skills and abilities. These are things that people can do, generally after practice over a period of time, and they're not usually the sorts of things people can do naturally (no one talks about the "skill" of chewing!). Performative knowledge is "knowing *how*". It is also called "functional" knowledge. At the post-secondary level, most performative knowledge presupposes and operationalizes a base of cognitive knowledge.

3. **Affective –** Values, attitudes and emotions. When we're talking about how we feel about something, our disposition toward it, or about values and principles we use to guide our behaviour, then we're

dealing with the affective domain. This kind of knowledge is closely connected to our emotions. Although universities have been declaring a commitment to affective knowledge for centuries, most still don't include intentional teaching and assessment of the affective domain in their programs.

So let's look at a few learning outcomes in detail. We'll make them learning outcomes about the same sort of object, in order to clarify differences between the three domains. The **active verb or phrase** will be highlighted in yellow, the **object** in green.

On successful completion of this course, students will be able to:

1. Explain the steps involved in at least two standard forms of historical research methodology.
   - This is a **cognitive** learning outcome, because it focuses the students' attention on demonstrating their knowledge of the steps involved in historical research. Note that it doesn't require them to demonstrate that they can actually do that research themselves!
2. Research and write articles using a standard form of historical research methodology that meets professional standards of style and format.
   - This is a **performative** outcome. Here the focus is on students' demonstration that they can actually research and write using a standard methodology. Note that the object is the same – the combination of outcomes 1 and 2 should give you a good sense of how well students understand the object from cognitive *and* performative perspectives.
3. Defend at least two standard forms of historical research methodology with an appeal to the underlying scholarly values and attitudes of professional historians that they embody.
   - This is an **affective** *and* **performative** outcome. The performative component is a skill (defence, which is a form, of argumentation), but they need to demonstrate that skill by appealing to the attitudes and values embodied in historical research. Clearly, in addition to combining the performative and affective domains, this outcome has two objects as well.

Now, if a student achieved all three of those outcomes, you'd have **good evidence that they understood** some aspects of standard forms of historical methodology from cognitive, performative, and affective perspectives. The three outcomes work together very well to engage students holistically with their object of study.

Why Care About Learning Outcomes?

Strategic use of learning outcomes in your teaching and course design can result in many potential benefits. A few of these are summarized below. References for further reading about the benefits and strategic use of learning outcomes are provided in the bibliography.

Better Learning

Learning outcomes can be used to provide guidance for students, so they know what is expected of them, and thus what they should focus on in their studying, attend to in class, and look for in their readings. This focused time-on-task means less time is wasted. They can also be used to set high expectations – which we then support with strategic and intentional teaching – so we push our students to learn more than they believe they are able. Students find outcome-based courses more rewarding, more effective, and less frustrating – even when they also report that the courses are more demanding!

Increased Motivation

Learning outcomes reinforce the belief that there is a real point to what is being taught and assessed, that there is a reason for what they experience in their courses. Students are less likely to become cynical and dismissive of courses that seem to have a point, and more motivated to take them seriously. Overall, students in outcome-based courses take a deeper approach to their learning, putting their efforts into actively trying to understand what they are learning, rather than simply memorizing lists of facts to get through an exam.

Better Performance on Assignments and Tests

Not surprisingly, when students know exactly what they are expected to demonstrate, they are better able to demonstrate those things. They spend less time trying to guess what the instructor wants and more time getting the job done.

Focused and Strategic Teaching

Anyone who has made the switch to outcome-based teaching will tell you that it can transform the way you plan courses and classes – for the better. By defining what students are supposed to know, value, and be able to do at the end of a course, you generate questions to guide your teaching – most importantly, "How will this lesson help students achieve the learning outcomes for this course?" It's a simple question with a big impact.

Once you have created learning outcomes for your course, you can use them to plan lessons that strategically target those outcomes, so that your classes have a greater likelihood of helping students learn what they need to learn. Each learning outcome excludes irrelevant teaching approaches and suggests a variety of approaches that will help your students succeed. Focused, intentional and strategic teaching "narrows the gap" between teaching and learning, so that when we teach, students learn.

Many people who have adopted a strategic, outcomes-based approach find that what they assumed were intractable problems with their students and their teaching vanish when courses, lessons, and assessments are outcome-oriented and mutually consistent.

Strategic Assessment

Just as learning outcomes can be used to create strategically-targeted lessons, they can be used to create strategically-targeted and appropriate assessment methods. Assessments that test whether students have met the learning outcomes are also likely to be consistent with the sorts of teaching methods that help students learn those outcomes. Assessment becomes part of the students' overall learning experience. The learning outcomes even provide a basis for assessment criteria.

Attention to Outputs

The use of learning outcomes helps us focus on the outputs of our work, rather than the inputs. We work with the students we have, and what matters, in the end, is how much they have learned and transformed between the time they meet us and the time they leave us – that's where we can make a difference. A student who enters our university by the skin of his teeth, barely meeting the entrance requirements, but graduates as someone able to meet our highest expectations is the sort of success story we should be writing.

Meeting Requirements

Even if none of the benefits mentioned above appeals to you, perhaps the following will suffice: program-level learning outcomes are now required for university programs in Ontario, they are increasingly being required by professional accreditation boards, and outcome-based education is now the de facto approach to post-secondary education in the English-speaking world – because the benefits of an outcome-based approach are so widely recognized.

In an increasingly competitive globalized world, Canada can no longer afford to fall behind.

Common Problems with Learning Outcomes

Certain problems with learning outcomes are quite common, so don't beat yourself up if you run into them. Well, don't beat yourself up anyway; self-flagellation is always a terrible thing to do. Moving on . . .

THE SINISTER SIXTEEN: Verbs that are Passive, Internal and/or Otherwise Unobservable

The most common verbs and phrases we see in learning outcomes are all unacceptable:

- Understand
- Appreciate
- Comprehend
- Grasp
- Know
- See
- Accept
- Have a knowledge of
- Be aware of
- Be conscious of
- Learn
- Perceive
- Value
- Get
- Apprehend
- Be familiar with

All of these are **internal**. In other words, they aren't public and can't be observed. You can never really know whether Barry understands the concept of derivatives, because you can't see into Barry's mind. All we have to go on are public behaviours that we are willing to accept as evidence that Barry probably understands. To some extent, we'll *never* be absolutely certain, but with careful thinking, teaching, and assessing, we can get close.

To avoid falling into traps set by the Sinister Sixteen (and their synonyms), stop and ask yourself these questions:

1. Is this outcome public and observable?
    - If not, choose a different verb and repeat the question.

2. How will I, and the students, know when this outcome has been achieved?
    - If it will result in confusion, choose a different verb and repeat the question.

3. What would I be willing to accept as evidence that this internal state has been reached?
    - If you wouldn't be able to make a reliable inference, choose a different verb and repeat the question.

4. What sorts of behaviours or performances would I associate with someone who has reached this state?
    - If these aren't evident in the outcome, choose a different verb and repeat the question.

The Outcome Doesn't Follow from the Stem

Each learning outcome is just a **sentence-completion** exercise, when you stop to think about it. The sentence begins with the stem and ends at the end of the outcome. If your stem is "On successful completion of this course, students will be able to . . ." and your outcome is "Anatomy and physiology of the human leg", well, that doesn't make sense, does it? It isn't a complete English sentence.

Now, if the outcome were rewritten as "Label the anatomical features of the human leg and explain their physiological interaction in the motion of walking," the sentence would work much better. Plus, it's now an observable outcome.

The Outcome Focuses on the Means, Rather than the Ends

Sometimes people get so involved in thinking through their course that they end up mixing their teaching and assessment methods into their outcomes. Remember, the outcomes specify what you want people to be **able to do at the end of the course**, not what they do in the course. The teaching methods and learning experiences help them get to that point, and the assessment methods tell you whether they've reached that point, but the outcomes are what the successful students leave your course having learned and demonstrated *through* those means. The outcome shouldn't mention your teaching and assessment methods at all.

The Outcomes are all Low-Level or High-Level

Your course should feature a mixture of low-level, mid-level and high-level outcomes. If they all require low-level ability and effort, the course is too easy and the students probably won't learn much. If they're all high-level, it's probably too challenging, and they may not be able to learn what they need to achieve all of those lofty outcomes. And if they're all mid-level, the course will probably be boring, although students might learn something.

Ideally, you'll have outcomes at each of these levels, and you will use achievement of the lower-level learning to help students develop to the point where they can achieve the mid-level learning outcomes, and then on to the high-level outcomes.

Consider our three example outcomes from a couple of pages back:

1. Explain the steps involved in at least two standard forms of historical research methodology.

2. Research and write articles using a standard form of historical research methodology that meets professional standards of style and format.

3. Defend at least two standard forms of historical research methodology with an appeal to the underlying scholarly values and attitudes of professional historians that they embody.

Explanation doesn't require much, cognitively, so it's a low-level outcome. But you probably need to understand the steps of these methodologies well enough to explain them before you can move on to more complex tasks, so it's a worthwhile outcome to include. Researching and writing the article builds on the knowledge expressed in the first outcome, but applies it toward the creation of something new. The application of the methodology is mid-level, and the creation of a new product is either mid or high-level, depending on the product and its requirements. Finally, effective defence requires argumentation skills which, in this context, will also require a deep knowledge of the rationale and values behind these methodologies, so that's a high-level outcome. But it, too, builds on the first and second outcomes.

We'll come back to this issue later when we talk about Bloom's taxonomy and the SOLO Taxonomy.

Too Vague – Or Too Specific

It's more common for learning outcomes to be too vague than too specific. Saying that students will "demonstrate" something, for instance, doesn't usually provide much information – unless the outcome pertains to demonstration of a very obvious skill at a low level, such as "Demonstrate proper use of scissors to cut paper". Usually there's a much more informative active verb that you could use instead.

Aside from the fact that it's unobservable, another reason that "understand" is an inappropriate verb to use in learning outcomes is that it's incredibly vague. Virtually all teaching is intended to help students understand, and virtually all learning involves some sort of understanding (some of it quite trivial and banal, some complex and significant). So what kind of understanding are you looking for? How complex? What would you accept as evidence of the kind of understanding you expect students to achieve? Focus on those questions – on what are sometimes called "performances of understanding" (Biggs and Tang, 2009, p. 75) rather than mere "declarations of understanding" – and you can avoid vagueness.

On the other hand, you don't want your learning outcomes to be so specific (and thus inflexible) that they unnecessarily tie your hands when it comes to how you teach and assess. Nor do you want them to be so specific and narrow that they rule out any creativity or open-ended learning for your students. Writing, "Cut paper with Black and Decker #45 scissors at a 45-degree angle beginning at the lower-left corner" is probably far more specific than any situation will call for!

There's an art to this, because you need to walk a fine line between being specific enough that students understand what is required of them and you can use the outcome to guide your teaching and assessment decisions, yet open enough to allow for creativity and unexpected learning. You won't be able to predict or prescribe every bit of learning that could take place. Even if you could, would that really be a good idea?

Critically-Reflective Questions to Ask When Writing Learning Outcomes

The following questions can be used to help you complete critically-reflective self-evaluations regarding your learning outcomes – and they're worth returning to periodically as well, particularly when you reflect after a course is over.

1. If students completed your course having mastered these learning outcomes, and only these learning outcomes, would you consider the course a success?

2. If a colleague asked you why you chose these learning outcomes, how would you explain your decisions?

3. Why do the skills, concepts, attitudes, and values contained in these learning outcomes matter to you, to your course, to your discipline? Why should they matter to students?

4. What does this set of learning outcomes communicate about you as a teacher – your identity, values, concerns, theoretical affiliations, assumptions, presuppositions, etc?

5. Given the learning outcomes you've chosen, how does this course connect with other courses that are taught (or would likely be taught) in your department?
    a. How does it prepare students for the rest of their program?
    b. How does it build on what they would have learned before enrolling in your course?

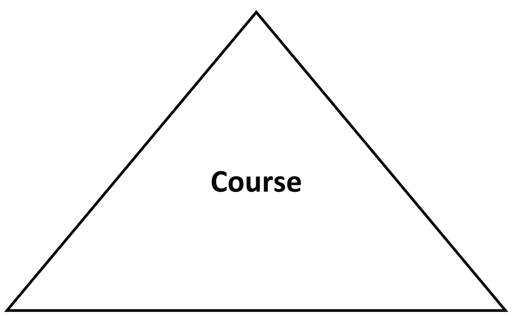
6. Which of your outcomes address likely threshold concepts and bottlenecks?

7. If a colleague said, "I think your outcomes expect too much (or too little)", how would you explain your choices?

Constructive Alignment: Outcomes, Methods, and Assessments

Learning outcomes are one of the three key components of a constructively-aligned course – that is, a course in which the **outcomes**, means (**teaching methods** and **learning experiences**), and **assessment tasks** are mutually consistent and supportive. The outcomes specify what students should achieve, the teaching methods and learning experiences help them achieve those outcomes, and the assessment tasks determine whether and how well the outcomes have been achieved.

Learning Outcomes



Means (Learning Experiences and Teaching Methods) **Assessment Tasks**

The Three Essentials of Alignment:

1) Teaching methods should help students develop the knowledge and skills specified in the learning outcomes. *The teaching methods are the means; the learning outcomes are the ends.*

2) Assessment tasks should determine whether, and to what degree, students have achieved the learning outcomes.

3) Teaching methods, assessments, and learning outcomes should be consistent and coherent.

Bloom's Expanded Taxonomy (Revised and Adapted)

Here are some active, public and observable verbs that you can use to communicate expectations at each level of Bloom's Revised Taxonomy, which we've adapted and changed to suit our needs. The first column indicates the likely level of complexity, from least to most. The second column suggests some verbs associated with each level of complexity. You don't need to use the verbs we've included; if you know better synonyms, go ahead and use them!

NOTES: Each level subsumes the ones beneath it. So, for instance, an outcome at the level of *application* presupposes that students can *remember* and *comprehend* the relevant information.

Although the verbs listed pertain specifically to the cognitive domain, some can be used for the affective domain – and all of them are expressed in performative terms! That's because **cognitive and affective knowledge is often impossible to assess unless it's integrated with some sort of behaviour**!

COGNITIVE and AFFECTIVE DOMAIN (Expressed in PERFORMATIVE Domain!)	
Recollection Recalling items of information	Recall, identify, recognize, acquire, distinguish, state, define, name, list, label, reproduce, order, indicate, record, relate, repeat, select, tell, describe, match, locate, report, choose, cite, define, outline, complete, draw, find, give, isolate, pick, put, show
Comprehension / Interpretation Constructing meaning from information	Translate, extrapolate, convert, interpret, abstract, transform, select, indicate, illustrate, represent, formulate, explain (who/what/when/where/that/how), classify, describe, discuss, express, identify, locate, paraphrase, recognize, report, restate, review, summarize, find, relate, define, clarify, diagram, outline, compare, contrast, derive, arrange, estimate, extend, generalize, give examples, ask, distinguish
Application Using information in new situations	Apply, sequence, carry out, solve, prepare, operate, generalize, plan, repair, explain, predict, instruct, compute, use, perform, implement, employ, solve, construct, demonstrate, give examples, illustrate, interpret, investigate, practice, measure, operate, adjust, show, report, paint, draw, collect, dramatize, classify, order, change, write, manipulate, modify, organize, produce, schedule, translate, complete, examine, advocate, persuade, resolve
Analysis Distilling and/or organizing information into its components; solving problems	Analyze, estimate, detect, classify, discover, discriminate, explore, distinguish, catalogue, investigate, break down, order, determine, differentiate, dissect, examine, interpret, calculate, categorize, debate, diagram, experiment, question, solve, test, dissect, deconstruct, focus, find coherence, survey, compare, contrast, classify, investigate, outline, separate, structure, categorize, determine evidence/premises and conclusions, appraise, criticize, debate, illustrate, infer, inspect, inventory, select, deduce, induce, argue, balance, moderate, identify, explain (how/why), challenge, question
Synthesis / Creation Relating items of information to each other, integrating them, and generating something new	Write, plan, integrate, formulate, propose, specify, produce, organize, theorize, design, build, systematize, combine, summarize, restate, discuss, derive, relate, generalize, conclude, produce, arrange, assemble, collect, compose, construct, create, perform, prepare, propose, strategize, compare, contrast, hypothesize, invent, discover, present, write, deduce, induce, bring together, pretend, predict, strategize, modify, improve, set up, adapt, solve, categorize, devise, explain (why), generate, manage, rearrange, reconstruct, relate, reorganize, revise, argue, extend, project, advocate, persuade, resolve
Evaluation Using standards, criteria, theories or processes to judge value	Evaluate, argue, verify, assess, test, judge, rank, measure, appraise, select, check, justify, determine, support, defend, criticize, critique, weigh, assess, choose, compare, contrast, decide, estimate, grade, rate, revise, score, coordinate, select, choose, debate, deduce, induce, recommend, monitor, compare, contrast, conclude, discriminate, explain (why), interpret, relate, summarize, challenge, question, advocate, persuade

The SOLO Taxonomy: Using Outcomes to Scaffold Learning

The *Structure of Observed Learning Outcomes* (SOLO) describes levels of progressively complex understanding, through five general stages that are intended to be relevant to all subjects in all disciplines. In SOLO, understanding is conceived as an increase in the ***number and complexity of connections*** students make as they progress from incompetence to expertise. Each level is intended to encompass and transcend the previous level.

The SOLO taxonomy was created by carefully analyzing student responses to assessment tasks (Biggs and Collis, 1982; Collis and Biggs, 1986), and has been validated for use in a wide range of disciplines (see Hattie and Brown, 2004 for a good list). In developing SOLO, Biggs and Collis took into account many factors that affect student learning, such as: students' prior knowledge and misconceptions, motives and intentions regarding education, and their learning strategies. The result is a construct that has both quantitative and qualitative dimensions.

The first level of SOLO is really a stage of ignorance that exists outside of the taxonomy. The next two stages (unistructural and multistructural) are both levels of surface understanding, in which knowledge (usually concrete knowledge) accrues in greater quantity. No increase in quantity – in the number of facts or ideas known – can result in depth of learning. Depth comes with a qualitative change in how ideas are *understood* in connection with other ideas. These connections are connected to increasing abstraction, so the last two levels of SOLO are characterized not only by the integration and connection of knowledge but also, necessarily, by increased abstraction. Such qualitative change is cognitively challenging, but Biggs and others who have written about SOLO advise us to remember that the later levels of SOLO aren't necessarily more "difficult" than previous levels; after all, remembering a vast number of discrete facts can be quite difficult. That doesn't make it useful, either. Hattie and Brown (2004, pp. 17-18)write, "Depth is not the same as difficulty – perhaps it is this confusion that explains why so many questions posed by teachers do not require students to use higher-order thinking skills but instead require a greater attention to details".

Although all five levels are part of SOLO, its designers (and many other writers since), often see the first and last stages as existing outside of the learning cycle per se. The way it works is pretty simple. At the pre-structural level you haven`t yet entered the learning cycle. The learning cycle is the sequence of stages from unistructural to relational, in which your understanding grows and deepens. You may need to go through various levels within the learning cycle multiple times as new ideas are brought in, but the goal is for you to leave the learning cycle eventually by reaching the extended abstract stage (See Panizzon, 2003; Pegg, 2003; Levins and Pegg, 1993; Pegg, 1992; Campbell et al, 1992).

The important fact to remember about these learning cycles is that you may find yourself in a different learning cycle for each topic or theme that you`re learning about, and in each of those learning cycles you may be at a different level of SOLO! Furthermore, even if a student has reached the extended abstract level of understanding about a topic, he or she may regress back to a previous level if hit with new information that shakes her understanding of the topic. That`s okay.

While some use SOLO as an alternative to Bloom's Taxonomy, which has some well-known problems (see Hattie and Brown, 2004, pp. 35-38), we believe the two are best used to complement each other, to help us think about our teaching and course design in slightly different ways.[1] As Biggs and Tang (2009, p. 80) note, "the Bloom

[1] Bloom`s Taxonomy is more useful than critics like Hattie and Brown like to admit. Despite its problems, and the initially arbitrary way it was created, it is quite consistent with other taxonomies (such as Adams, Aschner, Carner, Clements, Pate and

taxonomy is a useful adjunct" for the creation of learning outcomes and the selection of teaching and assessment activities.

	SURFACE LEARNING		DEEP LEARNING	
(Pre-structural)	**Unistructural**	**Multistructural**	**Relational**	**Extended Abstract**

Concrete facts → → → → → → → → → → → → → → → → Abstract ideas
Few organizing dimensions → → → → → → Many organizing dimensions
Minimal consistency → → → → → → → → → → → Maximal consistency
No use of organizing principles → → → → → Complex use of organizing principles
Low cognitive capacity → → → → → → → → → → → → High cognitive capacity
No relationships → → → → → → → → → → → → → Multiple relationships
High need for closure → → → → → → → → → → → → → Low need for closure

Knowledge at multistructural level is more complex than knowledge at a unistructural level, and knowledge at a relational level is more complex than knowledge at a multistructural level. Each row beneath the SOLO levels in the table above is either a continuum of complexity or an affective response to information. More details about these dimensions of complexity and affective responses can be found in the descriptions of each SOLO level in the following paragraphs.

Stage of Ignorance: Pre-Structural

At the **pre-structural** level students do not yet understand the knowledge they are supposed to learn, maybe because they haven't been taught it yet! At this level, students don't know how to gather information about the relevant idea, how to organize it in relation to other ideas, and often don't get the point of the idea at all. Ideas may be applied simplistically at this level as well, if students believe they`re expected to be able to use them but don`t know how; they`re guessing. There are no outcomes or levels of Bloom's Taxonomy associated with this level of SOLO.

In response to questions, student answers at the pre-structural level demonstrate that they don't know the answer and/or that they don't understand the question. In the latter case, they may provide irrelevant information or just repeat something they've been told (or believe they've been told). For example, if the question is, "Why use the SOLO taxonomy to create learning outcomes?" pre-structural responses might include:

- "I don't know"
- "We're supposed to"
- "That's what good learning is all about"

Stages of Surface Learning: Unistructural and Multistructural

The demand placed on students' memories and attention spans is low at these stages, increasing only in proportion to the number of ideas that need to be recalled. Neither of these two stages requires students to understand relationships between ideas: though the multistructural stage may require students to remember

Bremer, Schreiber and Guszak) and, in fact, can be used to integrate other taxonomies into a coherent structure. See Brabrand and Dahl (2009) for details.

several aspects of a whole, the relationship of those parts to each other is not understood. Because relationships are not used or understood at these stages, it is quite easy for students to believe completely inconsistent ideas without realizing it. Learning at these quantitative levels tends to be about memorization, acquisition of ever greater numbers of ideas, then either reproducing them or applying them in a procedural and predetermined manner.

At the **unistructural** level students have learned a relevant aspect of the whole. They may be able to make simple and obvious connections, but the meaning, value and significance of the idea may still be unclear to them, or they may not really see it at all. Sometimes their comprehension of the idea might still be disconnected, unnecessarily reductionistic, or oversimplified. Still, they may be able to achieve outcomes connected to the idea at the levels of *recollection* and *comprehension/interpretation* of Bloom's Taxonomy.

Common verbs for **unistructural** learning outcomes (adapted from Brabrand and Dahl, 2009):

> Paraphrase, define, identify, count, name, recite, follow simple instructions, calculate, reproduce, arrange, recognize, find, note, seek, sketch, pick

To move from pre-structural to unistructural:

- Misconceptions and erroneous beliefs that could impede understanding need to be surfaced and dealt with. Students must learn the "ground rules" of the discipline – what it accepts, what its standards are, its jargon, its assumptions, what it considers evidence, how it conducts research, and so forth. Students at the prestructural and unistructural stages, especially, need more structure if they are to learn, because the mass of new information is chaotic to them (McKeachie et al, 1990; Entwistle and Entwistle, 1992).

In response to questions, student answers at the unistructural level will provide a relevant fact or correctly identify something, but in isolation. There is no explanation that ties the fact to other facts, provides context, or relates the fact to relevant considerations and contextual factors. Or the student might try to apply a single idea, process, theory to a problem, but since it isn`t really understood, the solution is likely to be poor. For example (again!), if the question is, "Why use the SOLO taxonomy to create learning outcomes?" unistructural responses might include:

- "It helps you choose appropriate expectations"
- "It helps you plan an assessment strategy"
- "It helps you organize a useful sequence of learning experiences"
- "It helps you to use outcomes to encourage deeper approaches to learning"

At the **multistructural** level students understand several relevant aspects of a whole idea – or several ideas that are related to each other in some way, though they may not understand the relationships very well. Now they can make some connections and might have learned several "bits" quite well, but they struggle to see the "big picture". They still can't really see the organization behind the ideas, and their true significance is not well understood. The *quantity* of ideas understood in some way has increased, but they are alienated from each other and still quite concrete. At this point they may be able to achieve some relevant outcomes at the levels of *comprehension/interpretation*, *analysis*, and perhaps even *synthesis/creation*.

Common verbs for **multistructural** learning outcomes (adapted from Brabrand and Dahl, 2009):

> Combine, classify, structure, describe, enumerate, list, do algorithm, apply method, account for, execute, formulate, solve, conduct, prove, complete, illustrate, express, characterize

- *To move from unistructural to multistructural:* Individual ideas need to be "overlearned" so that retrieval of them becomes automatic; this frees up memory and attention span to focus on multiple ideas because students don't need to concentrate to remember each one. Students should practice using these ideas to explain things, make sense of information, etc., so an understanding of how the ideas relate to the world can develop.

In response to questions, student answers at the multistructural level will provide several relevant facts or correctly identify many characteristics of a phenomenon, but these facts are not integrated -- each remains unconnected to the others. As with the unistructural level, there is no explanation that ties the fact to other facts, provides context, or relates the fact to relevant considerations and contextual factors. For example (again!), if the question is, "Why use the SOLO taxonomy to create learning outcomes?" a multistructural response might include *all* of the following:

- "It helps you choose appropriate expectations, plan an assessment strategy, organize a useful sequence of learning experiences, and use outcomes to encourage deeper approaches to learning"

Referring back to the table on page 10, the unistructural and multistructural levels tend to place lower cognitive demands on students' attention spans and working memories. Although the number of facts students are expected to remember at the multistructural level may tax studnets' working memories, since they aren't expected to understand how those facts relate to each other, the demand is still less than it would be if the same quantity of facts were required at the qualitatively more challenging relational level. In terms of consistency, the unistructural and multistructural levels tolerate quite a lot of inconsistency among student beliefs – until information is integrated and connected, inconsistencies won't be spotted. On the other hand, the affective *desire* for consistency and closure will probably be greater if students are aware that they don't understand how the facts fit together. This desire may reinforce the low level of their responses, as many students will provide less information in (for instance) their answers to questions posed, in order to maintain the appearance of consistency. Others may throw a multitude of facts at the question in the hope that one of them will be the right answer. In terms of structure and the use of organizing principles, unistructural knowledge just requires students to provide a relevant piece of information in response to a question, which requires only the barest semblance of structure and no organizing principle. Multistructural knowledge doesn't require much more, just more instances of unistructural knowledge.

Stages of Deep Learning: Relational and Extended Abstract

At these stages the demand on students' memories and attention spans is much higher; not only do more ideas need to be remembered, they also need to be connected to each other and explained in some way. Relationships are essential to both stages of deep learning – at the extended abstract level, students need to be able to relate ideas beyond what they have already learned, generalizing to entirely new or imagined experiences. The demand for relationships to be understood at these stages forces students to reconcile inconsistencies between ideas through synthesis and/or evaluation. Learning at these more qualitative levels is what we usually mean when we speak of understanding. It involves discovering or creating meaning.

What we might call critical thinking is impossible in any meaningful way prior to the relational level, as it requires students to grasp the relationships between ideas in order to find similarities and differences, spot inconsistencies, make judgments about reliability and accuracy, compare points of view and integrate evidence in order to deduce principles for decision and action. The learning required to function effectively as a critical thinker is deep, involving not only changes in how we understand a topic, but also an ability to understand how others who think quite differently from ourselves might see the same topic. Thus, effective critical thinking is dependent on theoretical and metatheoretical (that is, theorizing about theorizing) knowledge. Traditionally, universities have not been effective in getting students past the multistructural level, having amassed a lot of short-lived superficial details (see, for instance, Ramsden 1992), which means that getting students to the point at which they can be critical thinkers in our disciplines is no easy task.

At the **relational** level students can integrate ideas into a whole, recognizing relationships and connecting ideas to each other. They may understand some "behind the scenes" meta-connections, find relationships between theory and practice, purposes, and the significance of ideas is clearer to them. Patterns are exposed – or imposed on the ideas. Some students at this level may be able to use this understanding to apply ideas to new situations. The shift is qualitative – it's a shift in how ideas are *understood*, because students have moved beyond the concrete into the abstract. Learning outcomes at the levels of *analysis*, *synthesis/creation* and *evaluation* are appropriate here. Most university courses (in fact, entire programs) do not bring students past this level; the multi-structural level may be the most common level for graduating students.

As the structure of students` knowledge improves, their motivation to take a superficial approach to learning decreases; they begin to adopt deeper approaches to their learning with greater frequency (Boulton-Lewis, 1994).

Common verbs for **relational** learning outcomes (adapted from Brabrand and Dahl, 2009):

> Analyze, compare, contrast, integrate, relate, explain causes, apply theory (to its domain), argue, implement, plan, summarize, construct, design, interpret (some senses), structure, conclude, substantiate, exemplify, derive, adapt

- *To move from multistructural to relational:* In addition to further "overlearning" of individual ideas, students need to practice investigating connections between ideas, reasons for them, ways in which they can be organized and explained relative to each other. Further practice with application can help this along, but they should also be encouraged to take ideas apart and put them back together, or organize them in new ways.

In response to questions, student answers at the relational level will provide explanations that relate and integrate relevant details, often expressed in terms of abstract ideas that bring concrete facts together. Relational answers may also bring in prior knowledge (knowledge students had before they entered the course) to augment their explanations and provide context. For example (yes, again!), if the question is, “Why use the SOLO taxonomy to create learning outcomes?” a relational response might look something like this:

- “SOLO helps you set appropriate expectations, as expressed in your learning outcomes, because it can be used to diagnose the level of learning you expect and revise accordingly, to take into account the level at which students begin and the level at which you’d like them to leave. This means you can use it to encourage deeper approaches to learning by ensuring that you expect neither too much nor too little and providing a framework to strategically organize the learning experiences you plan. If used as part of a constructively-aligned course, SOLO will also help you create assessment tasks that help you to accurately judge the quality of student learning while being effective learning experiences in themselves.”

Finally, we reach the ideal. At the **extended abstract** level students can organize, judge, and generalize the whole of their learning in order to use and adapt their knowledge in new situations. They can make connections between their courses, as well as between their courses and the outside world, and use those connections to enhance their understanding. They are able to sift out the underlying principles and structures behind the ideas they have learned, surface and evaluate embedded assumptions, consider multiple possibilities, and refine their academic learning continuously by integrating it with life experience as they engage with the world. In other words, extended abstract is, well, *abstract*. Outcomes at the levels of *synthesis/creation* and *evaluation* in Bloom’s Taxonomy are best at helping students reach this final level of SOLO.

Common verbs for **extended abstract** learning outcomes (adapted from Brabrand and Dahl, 2009):

> Theorize, generalize, hypothesize, predict, judge, transfer theory (to new domain), assess, evaluate, interpret (some senses), critically reflect, predict, criticize, reason

- *To move from relational to extended abstract:* Practice with synthesis and evaluation will help students develop greater understanding of relationships between ideas and the reasons things are done a certain way, etc., and as they are forced to use this knowledge in increasingly unfamiliar, varied, situations, their ability to generalize and adapt will grow.

In response to questions, student answers at the extended abstract level will go a step further than relational answers, beyond what has been learned, by reasoning forward, anticipating possibilities, making multiple connections, and bringing in (or devising) principles to make their knowledge useful in new situations. Because extended abstracts go beyond what is expected (they exceed the “A-level”), providing useful examples of them is difficult. Yet, a response to “Why use the SOLO taxonomy to create learning outcomes?” at the extended abstract level might look a lot like a relational response, except the student may bring in considerations from other aspects of teaching, learning, curriculum or assessment theory. Or the student might reason out implications and complications of applying SOLO in practice, perhaps for purposes the creators of SOLO didn't have in mind, or discern higher-order principles that explain differences and similarities. At the extended abstract level, "the learner is forced to think beyond the given and bring in related, prior knowledge, ideas, or information in order to create an answer, prediction, or hypothesis that extends the given to a wider range of situations" (Hattie and Brown, 2004, p. 6).

Referring back to the table on page 10, knowledge at the relational and extended abstract levels requires more cognitive capacity than knowledge at the lower levels, since facts are abstracted and related to each other – and in the case of the extended abstract level, beyond the course to new ideas and new situations. Relationships between ideas must be analyzed, interpreted, synthesized and evaluated. At the extended abstract level, it must also be abstracted into organizing principles to guide reasoning and create generalizations. The demand for consistency is therefore greater as well, since once information is integrated and related, inconsistencies come to light and must be resolved. On the other hand, the greater depth of understanding will lead many students to see that absolute consistency is probably impossible due to human limitations, so the affective desire or consistency and closure decreases; students should become more uncomfortable with uncertainty and the possibility of unanticipated inconsistency.

Considerations to Keep in Mind

Many students remain at the **pre-structural** or **unistructural** levels because their prior misunderstandings and preconceptions are not surfaced and changed (see Ramsden, 1988). As Hattie and Brown (2004, p.2) write, "Students often come to lessons with already constructed realities . . . which if we as teachers do not understand and assess before we start to teach, can become the stumbling block for future learning". Some students may never advance to higher levels of SOLO – in fact may drop out of university entirely – not because they are stupid, nor because their instructors are generally ineffective, but because neither they nor their instructors realized that misconceptions were getting in the way of learning.

The learning outcomes you provide for students, and the instructions you give them for learning experiences and assessment tasks, function as **cues**. They indicate (implicitly or explicitly) the level at which students are expected to perform. If students are asked to list, most of them will believe that`s what`s expected of them. If they are asked to evaluate, most will try to evaluate. Keep that in mind as you develop your courses, lessons, and assignments. Sometimes, too, it is perfectly acceptable to expect lower-level outcomes – they function as stepping stones on the way to higher levels. Without rungs on a ladder, no one gets to the top.

SOLO can be used not to help you design learning outcomes, learning experiences, teaching methods and assessment tasks that "scaffold" your courses, helping students move from lower levels of understanding to higher levels. It can also be used to help you plan questions you can ask students in class and on tests, to ensure that students are challenged to think past the point of easy comfort, into the more difficult and sometimes unsettling levels of complexity demanded by the **relational** and **extended abstract** levels (in fact, one of the original purposes of SOLO was to help teachers develop questions; see Hattie and Brown, 2004).

Students do not necessarily move through all stages or start at the same place. And it is not always appropriate or possible to move them through all five stages in every course, though a course should attempt to help students reach at least the fourth level in some respects even in first-year courses. Nor are the surface stages necessarily bad: "It is a cliché, but it is difficult to be deep without some surface material to think deeply about" (Hattie and Brown, 2004, p. 26). It is possible to help some students reach the fifth stage in their first year.

Nevertheless, by the end of a program, by the time they receive a degree, a good proportion of students should be thinking at the extended abstract level *vis-à-vis* the disciplinary content and skills they have learned. Making students aware of the taxonomy and the possibility of swift progress can help them reflect upon, and take charge of, their own learning, thus better enabling them to reach the fifth level.

For more information about the SOLO Taxonomy, the best source is Biggs and Tang (2009), pp. 76-80.

The table on the next page summarizes the text above and suggests activities to help students learn knowledge at each level and progress to the next. Note that it may be necessary to begin at lower levels of SOLO in order to help students understand well enough to "move up the ladder".

LEVEL OF UNDERSTANDING	BIGGS DESCRIPTION	TYPICAL CHARACTERISTICS	BLOOM LEVELS	SUGGESTED ACTIVITIES
1. Pre-Structural	Students do not understand	• Gather alienated items of information • No organization of information • No meaning • No demonstrated understanding • Misses the point	None	None
2. Unistructural	Students learn one relevant aspect of the whole	• Simple, obvious, connections made • Focused on one aspect • Information still has little meaning • Value and significance unclear • Concrete level • Unnecessarily reductive	Recollection Comprehension / Interpretation	• Identify content to be memorized, show examples • Provide disciplinary context • Mnemonics in groups • Repetition of procedures • Games • Repetitive testing and matching • Peer testing (one student asks, one answers)
3. Multistructural	Students learn several relevant independent aspects of the whole	• Some connections made • Focus on several aspects • Meta-connections between connections missing – each treated independently, additively • Some disorganization and alienation of related concepts • Significance of parts to whole is absent	Comprehension / Interpretation Analysis Synthesis / Creation	• Glossaries of key terms with definitions, classifications, examples to build disciplinary vocabulary • Simple laboratory exercises • Define terms, compare to glossary • Games modelled on Trivial Pursuit, Family Feud
4. Relational	Students learn to integrate several different aspects into a structure	• Some meta-connections • Connections between facts and theory, behaviour and purpose • Understanding and integration of significance of parts to each other, and parts to whole • Able to apply to some problem situations • Generally considered adequate to end here	Analysis Synthesis / Creation Evaluation	• Case studies, simulations and complex lab exercises • Concept maps • Research projects and experiential learning cycles • Application of theoretical models • Reflective journals • Student seminars and debates • Syndicate groups (each group is part of whole) • Problem-Based Learning and Inquiry Learning
5. Extended Abstract	Students can generalize what they learn into a new area of knowledge	• Connections with other information in discipline and beyond course, program and discipline • Generalization and abstraction of principles and underlying assumptions • Transfer to new experiences and unexpected problems	Synthesis / Creation Evaluation	• Self-directed projects involving research, design, application, argumentation, evaluation • Case studies involving extensive analysis, debate, reflection, argumentation, evaluation, forecasting • Development of a theory or model • Experiential learning cycles • Problem Based Learning and Inquiry learning • Teaching

Linking Outcomes to UWin Graduate Characteristics, UDLEs and GDLEs

Characteristics/Attributes of a University of Windsor Graduate A University of Windsor graduate will have the ability to demonstrate:	**COU-approved Undergraduate Degree Level Expectation (UDLE)**	**OCGS-approved Graduate Degree Level Expectation (GDLE)**
A. the acquisition, application and integration of knowledge	1. Depth and Breadth of Knowledge 2.Knowledge of Methodologies 3. Application of Knowledge 5.Awareness of Limits of Knowledge	1. Depth and Breadth of Knowledge 2. Research and Scholarship 3. Level of Application of Knowledge 6. Awareness of Limits of Knowledge
B. research skills, including the ability to define problems and access, retrieve and evaluate information (information literacy)	1. Depth and Breadth of Knowledge 2. Knowledge of Methodologies 3. Application of Knowledge 5. Awareness of Limits Knowledge	2. Research and Scholarship 3. Level of Application of Knowledge 6. Awareness of Limits of Knowledge
C. critical thinking and problem-solving skills	1. Depth and Breadth of Knowledge 2. Knowledge of Methodologies 3. Application of Knowledge 5. Awareness of Limits of Knowledge	1. Depth and Breadth of Knowledge 2. Research and Scholarship 3. Level of Application of Knowledge 4. Professional Capacity/autonomy 6. Awareness of Limits of Knowledge
D. literacy and numeracy skills	4. Communication Skills 5. Awareness of Limits of Knowledge	2. Research and Scholarship 5. Level of Communication Skills
E. responsible behaviour to self, others and society	Awareness of Limits of Knowledge Autonomy and Professional Capacity	4. Professional Capacity/Autonomy 6. Awareness of Limits
F. interpersonal and communications skills	4. Communication Skills 6. Autonomy and Professional Capacity	5. Level of Communication Skills
G. teamwork, and personal and group leadership skills	4. Communication Skills 6. Autonomy and Professional Capacity	4. Professional Capacity/Autonomy 5. Level of Communication Skills
H. creativity and aesthetic appreciation	2. Knowledge of Methodologies 3. Application of Knowledge 6. Autonomy and Professional Capacity	2. Research and Scholarship 4. Professional Capacity/autonomy 6. Awareness of Limits of Knowledge
I. the ability and desire for continuous learning	6. Autonomy and Professional Capacity	4. Professional Capacity/autonomy

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