Using the Revised Bloom's Taxonomy, Webb's Depth of Knowledge and SOLO Taxonomy to Analyse Learning Intentions

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What does it take to achieve an "A" in the Australian Curriculum?

Working with South Australian teachers to facilitate processes designed to moderate evidence of student learning against the Achievement Standards it has become increasing apparent that very little evidence of A standard achievement is evident. Why is this? In many cases, as teachers have come to realise, the task / unit / learning design does not offer the student the opportunity to demonstrate learning at higher levels.

The DECD Reporting Resource A to E guide (below) offers a guide designed to help educators determine the degree to which the Achievement Standard has been achieved but it is open to interpretation.

A few questions arise when we examine the wording. For example:

- What is the difference between thorough (A) and extensive (B) knowledge and understanding?
- How are knowledge and understanding different?
- What are the content, key ideas and concepts being assessed?
- What are the skills and processes being assessed?

Reporting Resource: A–E Guide

A guide to making on balance A–E grade judgements when reporting against Australian Curriculum achievement standards in DECD

Grade	Word Equivalent	A–E indicators - in relation to the achievement standard, the student has demonstrated
A	Your child is demonstrating excellent achievement of what is expected at this year level.	Thorough knowledge and understanding of the content, key ideas and concepts Very high level of competence in the skills and processes Uses these skills and processes in new contexts
B	Your child is demonstrating good achievement of what is expected at this year level.	Extensive knowledge and understanding of the content, key ideas and concepts High level of competence in the skills and processes Uses the skills and processes in some new contexts
C	Your child is demonstrating satisfactory achievement of what is expected at this year level.	Satisfactory knowledge and understanding of the content, key ideas and concepts Expected level of competence in the skills and processes Uses skills and processes in familiar contexts
D	Your child is demonstrating partial achievement of what is expected at this year level.	Basic knowledge and understanding of the content, key ideas and concepts Limited level of competence in the skills and processes Some ability to use skills and processes in familiar contexts
E	Your child is demonstrating minimal achievement of what is expected at this year level.	Very basic knowledge and understanding in a few areas of the content, key ideas and concepts Very limited competence in some of the skills and processes Beginning ability to use skills and processes in familiar contexts

Reporting Resource: A–E Guide (Revised version, published January 2017) Department for Education and Child Development

The instructional models examined in this resource can be used for both planning and assessment. It is important to be clear both about the **learning intentions** and the **evidence of learning** demonstrated. Sometimes the learning intention does not match what the student produces thus leading to questions of clarity and criteria for assessment.

Bloom's Taxonomy

Bloom's Taxonomy have often been used to devise tasks that propose to move from lower order thinking to higher order thinking. However, simply using the verbs to create tasks is not enough. For example, students could be working at the **knowledge** level to **describe** something, but the learning outcomes could be vastly different depending upon the complexity of the description as well as the complexity of the content

The revised Bloom's Taxonomy, builds on Bloom's original work and classifies knowledge dimensions as well as cognitive processes.

		The Knowledge Dimension			
		Factual The basic elements a student must know to be acquainted with a discipline or solve problems in it.	**Conceptual** The interrelationships among the basic elements within a larger structure that enable them to function together.	**Procedural** How to do something, methods of inquiry, and criteria for using skills, algorithms, techniques, and methods.	**Metacognitive** Knowledge of cognition in general as well as awareness and knowledge of one's own cognition.
The Cognitive Process Dimension	**Remember**				
	Understand				
	Apply				
	Analyse				
	Evaluate				
	Create				

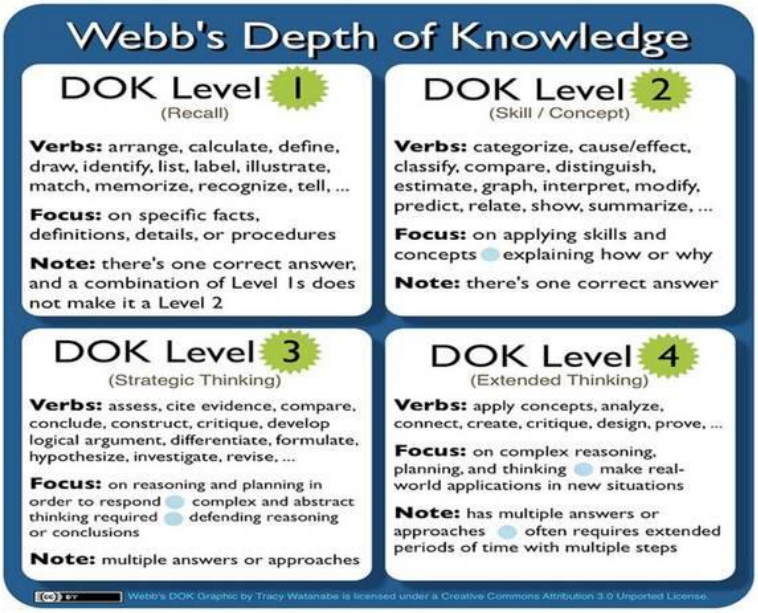
It is possible to examine the content and the achievement standards to determine the types of knowledge and processes required. Some learning areas divide the Achievement Standards into content and skills or proficiencies.
For example, year 5 Science

Verb / Process	Content / Knowledge	Qualifier
classify	substances	according to observable properties and behaviours
explain	everyday phenomena	associated with the transfer of light
describe	solar system	by key features
analyse	the form of living things	to explain how they function in their environments
discuss	scientific developments	to explain the effect on people's lives
		to explain how they help us solve problems
		to explain how science knowledge develops from many people's contributions
pose	questions	for investigation (whilst following instructions)
predict	effects	of changing variables (when planning)
use	equipment	safely and accurately
construct	tables and graphs	to organise data and identify patterns
compare	patterns in data	with predictions
describe	ways to improve fairness	of their investigations
communicate	ideas and findings	using multi-modal texts

Webb's Depth of Knowledge

Webb (1997) developed a process and criteria that can be used to review learning design. The Depth of Knowledge (DOK) model can be utilised to analyse the cognitive demands required of students to demonstrate their learning through completion of the task.

DOK LEVEL	requires the student to	EXAMPLES
Level 1: Recall and Reproduction	recall or reproduce knowledge or skills	Working with facts Demonstrating a skill Fluency activities in mathematics Reproducing a procedure in technology Listing Writing a procedure using a scaffold Locating information
Level 2: Skills and Concepts	utilise more than one step make some decisions about their approach	Explaining a science experiment Comparing two texts Organising information into another form e.g. timeline, model Summarising information Predicting outcomes of a procedure Research projects and writing activities that involve locating, collecting, organising and displaying information
Level 3: Strategic Thinking	to use planning and evidence think more abstractly choose and justify choices	Solving non-routine problems Designing an experiment Analysing characteristics of a genre Prepare and conduct a debate Solving a mathematical problem where several options are possible identifying a research question and designing and carrying out investigations
Level 4: Extended Thinking	synthesise information from multiple sources transfer knowledge from one learning area to solve problems in another	Design an original survey and interpret results Analyse multiple texts to extract themes / big ideas / author's intent Applying knowledge to solve ill-defined problems Research tasks that require extended thinking and formulating hypotheses over time Tasks that require collaboration and perspective taking



http://westcaryinstructionalresources.weebly.com

The following Maths and Science examples utililse both the Revised Bloom's Taxonomy and Webb's DOK and have been extracted from https://education.ohio.gov/getattachment/Topics/Teaching/Educator-Evaluation-System/How-to-Design-and-Select-Quality-Assessments/Webbs-DOK-Flip-Chart.pdf.aspx

Math & Science Alignment to Bloom's Taxonomy (source: Hess Math-Science CRM)

Revised Bloom's Taxonomy	Webb's DOK Level 1 | Recall & Reproduction
REMEMBER Retrieve knowledge from long-term memory, recognize, recall, locate, identify	▪ Recall, observe & recognize facts, principles, properties ▪ Recall/identify conversions among representations or numbers (e.g., customary and metric measures)
UNDERSTAND Construct meaning, clarify, paraphrase, represent, translate, illustrate, give examples, classify, categorize, summarize, generalize, infer a logical conclusion (such as from examples given), predict, compare/contrast, match like ideas, explain, construct models	▪ Evaluate an expression ▪ Locate points on a grid or number on a number line ▪ Solve a one-step problem ▪ Represent math relationships in words, pictures, or symbols ▪ Read, write, compare decimals in scientific notation
APPLY Carry out or use a procedure in a given situation, carry out (apply to a familiar task), or use (apply) to an unfamiliar task	▪ Follow simple procedures (e.g., recipe-type directions) ▪ Calculate, measure, apply a rule (e.g., rounding) ▪ Apply algorithm or formula (e.g., area, perimeter) ▪ Solve linear equations ▪ Make conversions among representations or numbers, or within and between customary and metric measures
ANALYZE Break into constituent parts, determine how parts relate, differentiate between relevant-irrelevant, distinguish, focus, select, organize, outline, lind coherence, deconstruct	▪ Retrieve information from a table or graph to answer a question ▪ Identify whether specific information is contained in graphic representations (e.g. table graph, T-chart, diagram) ▪ Identify a pattern/trend
EVALUATE Make judgments based on criteria, check, detect inconsistencies or fallacies, judge, critique	Not Applicable
CREATE Reorganize elements into new patterns/structures, generate, hypothesize, design, plan, construct, produce	▪ Brainstorm ideas, concepts, or terms related to a topic

Math & Science Alignment to Bloom's Taxonomy (source: Hess Math-Science CRM)

Revised Bloom's Taxonomy	Webb's DOK Level 2 | Skills & Concepts
REMEMBER Retrieve knowledge from long-term memory, recognize, recall, locate, identify	Not Applicable
UNDERSTAND Construct meaning, clarify, paraphrase, represent, translate, illustrate, give examples, classify, categorize, summarize, generalize, infer a logical conclusion (such as from examples given), predict, compare/contrast, match like ideas, explain, construct models	▪ Specify and explain relationships (e.g., non-examples/examples, cause-effect) ▪ Make and record observations ▪ Explain steps followed ▪ Summarize results or concepts ▪ Make basic inferences or logical predictions from data/observations ▪ Use models (e.g., diagrams to represent or explain mathematical concepts) ▪ Make and explain estimates
APPLY Carry out or use a procedure in a given situation, carry out (apply to a familiar task), or use (apply) to an unfamiliar task	▪ Select a procedure according to criteria and perform it ▪ Solve routine problem applying multiple concepts or decision points ▪ Retrieve information from a table, graph, or figure and use it to solve a problem requiring multiple steps ▪ Translate between tables, graphs, words, and symbolic notations (e.g., graph data from a table) ▪ Construct models given criteria
ANALYZE Break into constituent parts, determine how parts relate, differentiate between relevant-irrelevant, distinguish, focus, select, organize, outline, find coherence, deconstruct	▪ Categorize, classify materials, data, figures based on characteristics ▪ Organize or order data ▪ Compare/contrast figures or data ▪ Select appropriate graph and organize & display data ▪ Interpret data from a simple graph ▪ Extend a pattern
EVALUATE Make judgments based on criteria, check, detect inconsistencies or fallacies, judge, critique	Not Applicable
CREATE Reorganize elements into new patterns/structures, generate, hypothesize, design, plan, construct, produce	▪ Generate conjectures or hypotheses based on observations or prior knowledge and experience

Math & Science Alignment to Bloom's Taxonomy (source: Hess Math-Science CRM)

Revised Bloom's Taxonomy	Webb's DOK Leve13l Strategic Thinking & Reasoning
REMEMBER Retrieve knowledge from long-term memory, recognize, recall, locate, identify	Not Applicable
UNDERSTAND Construct meaning, clarify, paraphrase, represent, translate, illustrate, give examples, classify, categorize, summarize, generalize, infer a logical conclusion, predict, compare/contrast, match like ideas, explain, construct models	▪ Use concepts to solve non-routine problems ▪ Explain, generalize, or connect ideas using supporting evidence ▪ Make and justify conjectures ▪ Explain thinking when more than one response/solution is possible ▪ Explain phenomena in terms of concepts
APPLY Carry out or use a procedure in a given situation, carry out (apply to a familiar task), or use (apply) to an unfamiliar task	▪ Design investigation for a specific purpose or research question ▪ Conduct a designed investigation ▪ Use concepts to solve non-routine problems ▪ Use and show reasoning, planning, and evidence ▪ Translate between problem & symbol notation when not a direct translation
ANALYZE Break into constituent parts, determine how parts relate, differentiate between relevant-irrelevant, distinguish, focus, select, organize, outline, find coherence, deconstruct	▪ Compare information within data sets or texts or across related data sets ▪ Analyze and draw conclusions from data, citing evidence ▪ Generalize a pattern ▪ Interpret data from complex graph ▪ Analyze similarities/differences between research procedures or solutions
EVALUATE Make judgments based on criteria, check, detect inconsistencies or fallacies, judge, critique	▪ Cite evidence and develop a logical argument for concepts or solutions ▪ Describe, compare, and contrast solution methods ▪ Verify reasonableness of results
CREATE Reorganize elements into new patterns/structures, generate, hypothesize, design, plan, construct, produce	▪ Synthesize information within one data set, source or text ▪ Formulate an original problem given a situation ▪ Develop a scientific/mathematical model for a complex situation

Math & Science Alignment to Bloom's Taxonomy (source: Hess Math-Science CRM)

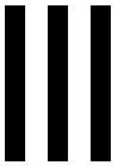
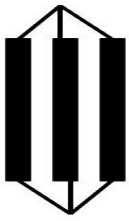
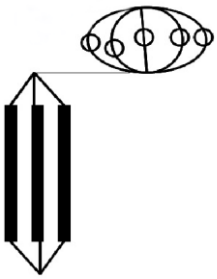
Revised Bloom's Taxonomy	Webb's DOK Level 4 | Extended Thinking
REMEMBER Retrieve knowledge from long-term memory, recognize, recall, locate, identify	Not Applicable
UNDERSTAND Construct meaning, clarify, paraphrase, represent, translate, illustrate, give examples, classify, categorize, summarize, generalize, infer a logical conclusion (such as from examples given), predict, compare/contrast, match like ideas, explain, construct models	▪ Relate mathematical or scientific concepts to other content areas, other domains, or other concepts ▪ Develop generalizations of the results obtained and the strategies used (from investigation or readings) and apply them to new problem situations
APPLY Carry out or use a procedure in a given situation, carry out (apply to a familiar task), or use (apply) to an unfamiliar task	▪ Select or devise an approach among many alternatives to solve a problem ▪ Conduct a project that specifies a problem, identities solution paths, solves the problem, and reports results
ANALYZE Break into constituent parts, determine how parts relate, differentiate between relevant-irrelevant, distinguish, focus, select, organize, outline, lind coherence, deconstruct	▪ Analyze multiple sources of evidence ▪ Analyze complex/abstract themes ▪ Gather, analyze, and evaluate information
EVALUATE Make judgments based on criteria, check, detect inconsistencies or fallacies, judge, critique	▪ Gather, analyze, & evaluate information in order to draw conclusions ▪ Apply understanding in a novel way, provide argument or justification for the application
CREATE Reorganize elements into new patterns/structures, generate, hypothesize, design, plan, construct, produce	▪ Synthesize information across multiple sources or texts ▪ Design a mathematical model to inform and solve a practical or abstract situation

Resources

Revised Bloom's Taxonomy at http://www.celt.iastate.edu/teaching/effective-teaching-practices/revised-blooms-taxonomy
Webb's Depth of Knowledge Guide at http://www.aps.edu/re/documents/resources/Webbs_DOK_Guide.pdf
Using Webb's Depth of Knowledge to Increase Rigor at https://www.edutopia.org/blog/webbs-depth-knowledge-increase-rigor-gerald-aungst

Appendix 1: AUSTRALIAN CURRICULUM English Achievement Standards (Foundation)					
		The Knowledge Dimension			
		Factual	**Conceptual**	**Procedural**	**Metacognitive**
The Cognitive Process Dimension	**Remember**	Recall one or two events from texts with familiar topics. Identify the letters of the English alphabet and use the sounds represented by most letters		Listen for rhyme, letter patterns and sounds in words.	
	Understand	Understand that texts can reflect their own experiences			They identify connections between texts and their personal experience
	Apply	Use predicting and questioning strategies to make meaning from texts Identify and use rhyme, letter patterns and sounds in words When writing, students use familiar words and phrases and images to convey ideas They correctly form known upper- and lower-case letters.	Listen to and use appropriate language features to respond to others in a familiar environment in informal group and whole class settings Communicate clearly retell events and experiences with peers and known adults Writing shows evidence of sound and letter knowledge, beginning writing behaviours and experimentation with capital letters and full stops.	Read short, predictable texts with familiar vocabulary and supportive images, drawing on their developing knowledge of concepts about print and sound and letters.	
	Analyse		Understand that there are different types of texts and that these can have similar characteristics		
	Evaluate	Identify and describe likes and dislikes about familiar texts, objects, characters and events.			
	Create				

Appendix 2: AUSTRALIAN CURRICULUM English Achievement Standards (Year 7)					
		The Knowledge Dimension			
		Factual	**Conceptual**	**Procedural**	**Metacognitive**
The Cognitive Process Dimension	**Remember**				
	Understand		Listen for and explain different perspectives in texts	Understand how text structures can influence the complexity of a text and are dependent on audience, purpose and context	Understand how the selection of a variety of language features can influence an audience
	Apply			Understanding of how the choice of language features, images and vocabulary affects meaning	
	Analyse			Make presentations and contribute actively to class and group discussions, using language features to engage the audience.	
	Evaluate		Understand how to draw on personal knowledge, textual analysis and other sources to express or challenge a point of view	When creating and editing texts they demonstrate understanding of grammar, use a variety of more specialised vocabulary, accurate spelling and punctuation	Explain issues and ideas from a variety of sources, analysing supporting evidence and implied meaning
	Create			Create texts showing how language features and images from other texts can be combined for effect Create structured and coherent texts for a range of purposes and audiences	Select specific details from texts to develop their own response, recognising that texts reflect different viewpoints

SOLO Level	Description	Thinking processes	Examples
 **Pre-structural**	• students do not yet understand • incorrect solution		
 **Uni-structural**	• simple obvious recollections made • focused on one aspect • concrete level of understanding • simple procedure	state recognise recall quote note name	Which is the planet furthermost from the sun? Estimate the size of an angle
 **Multi-structural**	• some basic connections made • focused on several aspects • significance of parts to whole connections not understood	explain define list solve describe interpret combine	Which planet is warmer - Venus or Mars? Estimate the size of an angle, measure the size of angles and learn the angle facts
 **Relational**	• connections made between facts and concepts • understanding of relationships between parts and the whole • able to apply to some problem situations	apply outline distinguish classify compare contrast summarise categorise explain causes	How does the movement of the Earth relative to the sun define day and night? Understands how estimation can be used as a way to check when measuring an angle. Understands how to use angles in parallel lines rules to prove angles in a triangle add up to 180 degrees. From this they can then derive the sum of the interior angles in an octagon.
 **Extended Abstract**	• generalisation of learning concepts • able to transfer to new experiences and unfamiliar problems • unique solutions to problems generated	create synthesise hypothesise predict debate theorise	Given the Earth's position relative to the sun, in what ways does this affect the Earth's climates and seasons? Applies angle fact knowledge to solve geometrical problems where the angles are algebraic expressions and the solution requires the formation and solution of equations.

http://pamhook.com/solo-taxonomy/
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