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Taxonomy Circles: Visualizing the possibilities of intended learning outcomes

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This paper reviews the existing literature and established protocols for the use of intended learning outcomes (ILOs) in UK higher education, stressing the need to incorporate a wider range of taxonomies than just the dominant notion of the cognitive. The paper then goes on to explore an alternative visualization of four educational taxonomies as 'taxonomy circles', structured to support effective and imaginative ILO design before concluding with an illustration of how this model might be applied in practice. It demonstrates how a comprehensive and coherent approach to ILOs across all domains, with visualization to enable faculty to engage with potentially complex conceptual relationships, could support both effective design processes and enable future adaptive learning scenarios and student-centred learning planning tools.

INTRODUCTION

Massive Open Online Courses (MOOCs), self -generated Open Educational Resources (OER) based curricula (Das, 2011), kite-marking schemes (Westerheijden, 2003) and elaborate credit transfer schemes are a reality in an increasingly complex higher education sector. Students are often pursuing studies from within the world of work, where physical mobility of employment precludes commitment to a single campus based programme over four years and requires well-defined, constructively aligned, module designs. Clever module design means intelligent programme design, coherent and dynamic portfolios and successful institutions. Learning design is no longer just an issue for the Quality Office; the 'strategy people' are beginning to care too. My articulation of modular level ILOs, represented as taxonomy circles with suggested associated learning and teaching activities, serve to support both the coherence of programme design and the ability for students to make selective, and corrective, choices in the assemblage of learning outcomes that they wish to achieve within their studies. A taxonomy is a classification of objects, items or artefacts, in this case 'verbs', into groups in some systemic process. The proposed 'taxonomy circles' may also serve, in a computerized and automated fashion, to provide a pedagogic rationale for adaptive learning systems' responses to students' engagement with defined competencies.

The vast majority of UK Higher Education produces detailed module and programme specifications for their syllabi. Specification templates used routinely throughout UK higher education detail the aims and objectives, resources, indicative schemes of work, staffing

requirements and modes of delivery. They also frequently advocate use of a template to generate the intended learning outcomes (ILOs) for the module or programme. Divided into three or four sections covering knowledge and understanding, intellectual skills (cognitive domain), professional and practical skills (affective domain) and general transferable skills (psychomotor skills), these templates are completed with varying degrees of comprehension as module validation panels will attest.

Taxonomy circles not only support faculty in designing effective learning, but also serve to provide students with a visual reference to the intended learning outcomes expected across four domains in any given University module, or course, allowing students to pick and choose modules to ensure appropriate coverage of skills and the appropriate level of attainment. Students' increasing need to be selective in the mode, location and focus of their study choices, to take advantage of credit transfer schemes, MOOCs and OER based curricula, requires transparency in ILOs. Clarity in meaningful ILOs provides students with the means to balance their study transcripts, plan course selections, and the freedom to articulate prior experiential learning and prior accredited learning.

Clearly articulated, and transparent to the student, a module specification with four categorizations of ILOs, such that a student could identify from their assessment evidence that they had met specific ILOs in a range of domains, promises greater mapping of awards, transportability of credit and adaptability. Such transparency would enable the student not only to have a useful platform to identify future learning needs, but also the potential to negotiate the accreditation of prior accredited learning in a much more fine-grained and meaningful way, something likely to become a significant feature of international higher education accords in the next few years as institutions face up to the challenge of accredited OER schemes and credit bearing MOOCs. The design of ILOs for modules and programmes will become an institutional strategic priority.

This paper begins with a review of the existing literature and established protocols for the use of ILOs in UK higher education, stressing the need to incorporate a wider range of taxonomies than just the dominant notion of the cognitive. The paper then goes on to explore an alternative visualization of four taxonomies as 'taxonomy circles', structured to support effective and imaginative ILO design before concluding with an illustration of how this model might be applied in practice. The paper seeks to illustrate that a comprehensive and coherent approach to the design of intended learning outcomes across all domains, with visualizations to enable faculty to engage with potentially complex conceptual relationships, could support and enhance effective design processes. It is also suggested that future adaptive learning scenarios and student-centred learning planning tools will require a greater degree of design sophistication across educational domains beyond the cognitive.

INTENDED LEARNING OUTCOMES AS A BASIS FOR COURSE DESIGN

The prevailing logic in United Kingdom higher education for some twenty years has been that to achieve a well-structured and constructively aligned curricula, the module team should determine what the ILOs for the module are to be (Biggs & Tang, 2007) in terms of what the learner will be able to do at the end of the module. Having determined the ILOs, the team should then determine how they would enable the student to demonstrate achievement of the outcomes and draft an appropriate assessment strategy. Then, and only then, the module design team would look at what the student needed to be able to demonstrate and

work out what was needed as input: outcomes first; assessment second and teaching inputs third.

It is not an easy thing to do. As teachers, we are passionate about our subjects, anxious to impart what we know is important, what 'did it for us', and at some point in this process many faculty will 'go native', reach for the seminal text (or the nearest thing to it, their own book), and start thinking about what the students need to know. This can, of course, produce fantastic learning experiences and there are a great many exciting modules drafted on the backs of envelopes without specification templates. They do not make for effective records of achievement, however, and they are unlikely to be structured in such a way as to enable adaptive learning processes.

Accreditation of prior accredited learning has always been a challenge and an effective template for module and programme design makes a significant difference, enabling students to identify from their transcript exactly what it is they can evidence as intended learning outcomes. Hussey and Smith (2008) support the usefulness of 'outcomes' or objectives at the level of an individual teaching event in their critical review of intended learning outcomes, although they remain critical of the 'bureaucratic burden' that ILOs have become. They distinguish between outcomes at the level of an individual teaching event, a module or course and at programme level. They suggest that only those specified, flexibly, at the level of the teaching event are effective and that module outcomes are frequently simply lists of contents. Outcomes at programme level should not, they suggest, be considered 'outcomes' at all (Hussey & Smith, 2008). The SOLE model supports Hussey and Smith suggesting that phases in learning and teaching activity, whether topics, weeks or some hermeneutical unit, should have notable objectives that map directly to the ILOs at module level thus making them effective (Atkinson, 2011a).

This alignment of outcomes at the level of the module and within teaching events, or individual teaching sessions, is a manifestation of what John Biggs called 'constructive alignment' of learning (Biggs & Collis, 1982). In adapting Bloom's taxonomy of educational 'objectives' (Bloom, 1984), Biggs constructed a model of integrated and interdependent processes for curriculum designers that promoted an alignment of the learning outcomes and assessment, as well as the associated teaching experience of the learner (Biggs & Tang, 2007). Biggs advocates that well-articulated 'verbs' for the ILO *(learners will be able to synthesise data on the underlying social causes of gang membership)* should be reflected in the associated assessment that asks the students to demonstrate they have met that outcome *(learners will be assessed on their ability to synthesise data on the underlying social causes of gang membership)*. Consequently, the learning and teaching activities undertaken in the classroom (or online) would be expected to 'rehearse' both the active verb of the ILO and the assessment task. One might expect to see students getting some practice at synthesising data. If the learning experienced by the student does not 'activate' the verb, it is not possible to ensure learners will be able to evidence their attainment of the learning outcomes (Boud & Falchikov, 2006).

HOLISTIC LEARNING

All too often Higher Education stresses the cognitive, over reliant perhaps on Bloom's taxonomy and the focus of Biggs's SOLO Taxonomy (Biggs & Collis, 1982), and neglects the affective and psychomotor domains. This is has several consequences; it relegates anything

that is not seen as 'intellectual', the linguistic and logical-mathematical intelligences (Gardner, 1993), to a lower order of skills despite the fact that employers and students recognise and demand the need for broader skills (Mason, Williams, & Cranmer, 2006). In so doing, it forces programme leaders into 'bolt-on' skills modules that demand additional institutional resource and student resource and frequently ill serves the purpose. No learning design is truly student-centred if it is neglecting any domains of experience (Atkinson, 2011b).

The model of ILO development advocated here separates the knowledge domain and the intellectual (cognitive) skills, focusing the module designer on the 'skills' that will be acquired independent of the subject knowledge being developed. This, along with a focus on the affective and psychomotor skills, provides a framework for a module that is balanced in terms of what the student does, the context in which they do it, and, correctly assessed, ensures all these intended learning outcomes can be justifiably claimed in the student's transcript.

Indeed, it is not difficult to imagine a student coming to the end of the first stage of their degree, and given the sufficiently transparent and coherent insight into their own skills development, being able to recognise that they have excelled in the psychomotor skills but struggled in the cognitive. Were this the case a student could make module choices for future stages either to redress that balance or acknowledge their strengths and adjust choices to reflect future career path.

THE DOMAINS

Before proposing alternative visualizations of ILOs, I will briefly review what these four sections, or domains, of Intended learning outcomes represent. They are:

- Knowledge and understanding – subject domain
- Intellectual Skills – or the cognitive domain
- Professional Skills – or the affective domain
- Transferable Skills – or the psychomotor domain.

Knowledge and understanding – subject domain

The subject domain is often conflated with the cognitive domain, which is understandable as this is incorporated within Bloom's ubiquitous taxonomy, but this does tend to confuse faculty as to the distinction between knowing and understanding a body of factual knowledge and being able to do something with that factual knowledge. The subject domain can, and in my opinion should, be limited to defining the subject area for illustrative purposes for the student. Since the principle is that all ILOs should be assessed, and it is actually rather difficult to assess whether someone 'understands' something without having them 'operationalize' the knowledge, I tend not to get too hung up on the active verbs used in this domain, contenting myself that the verbs serves to contextualise what follows.

Intellectual Skills / Cognitive domain

This domain refers to 'knowledge structures' building from the base of the subject domain, the 'knowing the facts', towards high order thinking skills in which these facts become

operationalized and transferable. This domain is familiar to most faculty and synonymous with the work of Bloom from the 1950s (Bloom, 1984) and the useful revisions made in 2001 (Anderson & Krathwohl, 2001). It is regrettable that much of the guidance to university faculty appears to stop with the cognitive domain, an indication perhaps of the sector's focus on linguistic and logical-mathematical intelligences at the expense of most others.

Professional Skills / Affective domain

The affective is concerned with an individual's values, and includes their abilities with respect to self-perception through to abstract empathetic reasoning. In an extension to the early work by Bloom, progressive stages take the learner from foundational 'receiving', through to the 'internalization' of personal value systems (Krathwohl, Bloom, & Masia, 1999). In the context of Higher Education programmes, particularly in an era when the employability of graduates is stressed, an awareness of these professional values is surprisingly absent from many module designs. UK employers' associations and central government have placed significant pressure on UK Higher Education Institutions (HEIs) since the late 1990s to equip graduates with the skills required for employment and workforce preparation. Variously identified as 'key', 'core' and 'transferable' skills, these have centred on those skills identified in the Dearing Report (Dearing, 1997), of communication, numeracy, information technology and 'learning how to learn'. To these have been added 'commercial attitudes and understanding' (Hillage & Pollard, 1998) as well as 'self-sufficiency' and self-career management. To these can be further added 'digital literacies' as a set of skills necessary to work in increasingly distributed and digitally enabled contexts (Burden & Atkinson, 2010).

Transferable Skills / Psychomotor domain

Transferable skills are often very poorly articulated, even to the extent of being referred to by implied generic synonyms such as 'communication skills' or 'interpersonal skills'. The psychomotor domain is certainly less well researched and documented and this has meant a less than adequate recognition and incorporation into learning designs. Frequently, tactile or technical skills become seen as 'general skills' or 'transferable skills' with little sense of progression. Properly applied, this educational domain refers to progressively complex manual or physical skills and so could identify the progressively complex skills of a biologist in using a specialist microscope, or an economist using a statistics software package (Dave, 1967).

RE-VISIONING TAXONOMIES

Having established that intended learning outcomes are potentially an effective way of articulating the structure and intention of the learning to be undertaken by learners, it is helpful to look at how such outcomes might be identified and structured. In this section I will look at how visualisations, in the form of 'taxonomy circles', can support the effective design of outcomes. I will then go on to illustrate the use of these circles in structuring the activities used to evidence these outcomes.

The passively descriptive language of Bloom's Taxonomy has become the active language of Anderson and Krathwohl (Anderson & Krathwohl, 2001). The taxonomies have moved from *Evaluation* to *Evaluate*, from *Analysis* to *Analyse*. This is significant in that the emphasis has moved away from describing what the focus of the teaching is supposed to

be, to the demonstrable outcomes of the learning. This is a significant shift in the language we now use from the original work in the 1950s by Bloom and colleagues.

The four 'working circles' that follow use adaptations of taxonomies cited above and detailed in Table 1 from Anderson and Krathwohl (Knowledge and Understanding, and Cognitive), Krathwohl et al (Affective) and Dave (Psychomotor). I have adapted the Knowledge Dimension of Anderson and Krathwohl to do two things: to describe the dimension in terms of active verbs rather than as a definition of the nature of the knowledge itself, and to incorporatea stage I believe is under represented in their articulation. I have added the ability to 'contextualise' subject knowledge between the ability to specify it (factual) and the ability to conceptualize (conceptual). I have also rearticulated the original 'Metacognitive' as the ability to 'Abstract'. This will doubtless need further work to articulate through practice. The intent is not to dismiss the valuable work already in evidence around the epistemic relationship between a knowledge dimension and the cognitive domain(Muis & Franco, 2010), rather it is to enable faculty, specifically when writing learning outcomes, to identify the subject, discipline or knowledge to be enabled in more meaningful ways. In all cases the language has been modified towards the active verb structures required for stating ILOs.

Table 1 - Domains, Proto-verbs and Descriptors

Domains, proto-verbs and descriptors			
Cognitive (Anderson & Krathwohl, 2001)	**Affective (Krathwohl et al., 1999)**	**Psychomotor (Dave, 1967)**	**Subject – adapted from (Anderson & Krathwohl, 2001)**
Remember & Understand – ability to recognise information and comprehend it and to recall and restate said information.	**Receive** – ability to learn from others.	**Imitate** – ability to copy, replicate the actions of others following observations.	**Specify** – ability to locate, identity and recognise factual knowledge, dates, terminology, artefacts (audio and visual) required of a given discipline domain.
Apply – ability to apply factual information and presented theories, models and structures to real world contexts and problems.	**Respond** – ability to participate responsibly, respectfully and actively as appropriate to the context.	**Manipulate** – ability to repeat or reproduce actions to prescribed standard from memory or instructions.	**Contextualize** – ability to place specific knowledge within appropriate discipline relationships, classifications, taxonomies and categorizations.
Analyze – ability to construct complex relationships from single factual elements, reconstruct relationships and assess needs.	**Value** – ability to associate personal and collective values with contextual experience and express value judgments.	**Perfect** – ability to perform actions with expertise and without interventions and the ability to demonstrate and explain actions to others.	**Conceptualize** – ability to articulate relationships between knowledge contexts and to work with models, visualizations, theories and structures that relate between contexts or within contexts.
Evaluate – ability to make complex judgments about the nature of context, information and processes	**Organize** – ability to structure, prioritize and reconcile personal and others' value systems.	**Articulate** – ability to adapt existing psychomotor skills in a non-standard way, in	**Process** – ability to utilize subject or discipline language and actions to specify, contextualise and

to establish new conclusions not represented in the original information.		different contexts, using alternative tools and instruments to satisfy need.	conceptualize existing and new knowledge.
Synthesize – ability to create new representations of knowledge structures, combining complex assemblages of information in original contexts	**Internalize** – ability to articulate one's own values and belief systems and operate consistently within them	**Embody** – ability to perform actions in an automatic, intuitive or unconscious way appropriate to the context.	**Abstract** – ability to recognise and process abstract, unseen or unspecified knowledge, and articulate knowledge origination, including meta-cognition.

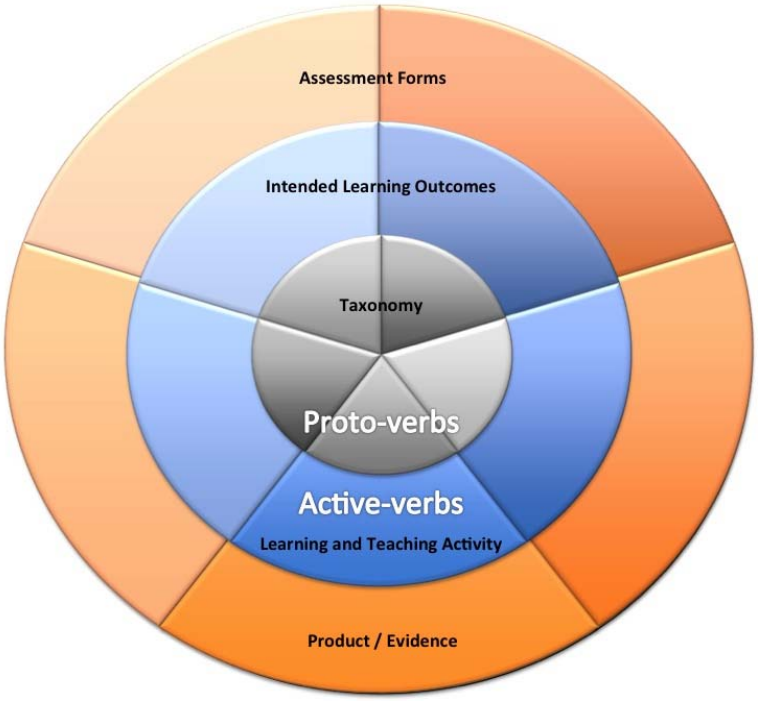
The illustrations that follow (Figures 3, 4, 5 and 6) represent four visual 'circles' that have been used to discuss learning outcomes with faculty in the context of module and programme design at Massey University in New Zealand, the London School of Economics and BPP University College in the United Kingdom. These visual representations were inspired by work done elsewhere, on the cognitive domain in particular. The first documented example of this circular representation is attributed to Barbara Clark (Clark, 2002) but a great many people have since represented Bloom's original, and the revised, cognitive domain in this way.

Faculty and learning designers can be supported to see ILOs take shape and many find existing lists are uninspiring. It is not uncommon for faculty and instructional designers to get tired and weary of ILOs; they can feel restrictive, repetitive, formulaic and sometimes obstructive. Taxonomies are frequently presented to faculty as lists of verbs. This makes the structure and relationships between domains and within domains accessible to some but not all. As an alternative, a visual representation may provide a greater degree of flexibility for contextualisation for those inclined towards such representations of knowledge. The representation of the domains as circles may in and of itself still not be not sufficient to allow all faculty to access the underlying principles. Professional development workshops around a presentation of the taxonomy circles have been successfully undertaken, but the intention remains to make the 'model' of the taxonomy circles as accessible as possible in the form of a 'toolkit' in order to allow them to access the underlying educational theories that support the taxonomies in application. As Conole suggests, 'the development of toolkits provides a way for non-specialists to engage with such theories in a manner which supports careful design and prompts productive reflection and engagement' (Conole, Dyke, Oliver, & Seale, 2004, p. 18).

The four domain representations, in Figures 3, 4, 5 and 6 take the following structure as illustrated Figure 1. Each circular representation has the higher-level terms at the centre, proto-verbs, derived from pre-existing taxonomies with some adaptation. Surrounding these is a series of active verbs that articulate actions an individual might undertake to generate evidence of their ability to represent the proto-verb. The final outer circle suggests the means by which a student might provide evidence of their having demonstrated successfully a particular active-verb, and hence proto-verb. This outermost circle also serves to identify educational technologies and alternative assessment forms in order to get faculty thinking more broadly about how they can assess things online as well as in more traditional settings. The outermost circle will continue to evolve as our use of

educational technologies evolves. The circular visualisations serve to create a more fluid representation of the stages, or divisions, in the proto-verbs than lists of words. Rather than a strict 'step-by-step' list where one advances 'up' the proto-verbs, one might consider this almost like the dial on an old telephone, in every case one starts at the 'foundational' and dials-up though the stages to the 'highest' level. Each level relies on the previous. It may be implicit, within the cognitive domain for example, that to analyse something, one will already have acquired an ability to apply it, and that application is grounded on subject knowledge and understanding.

Figure 1 - Structure of Taxonomy Circles

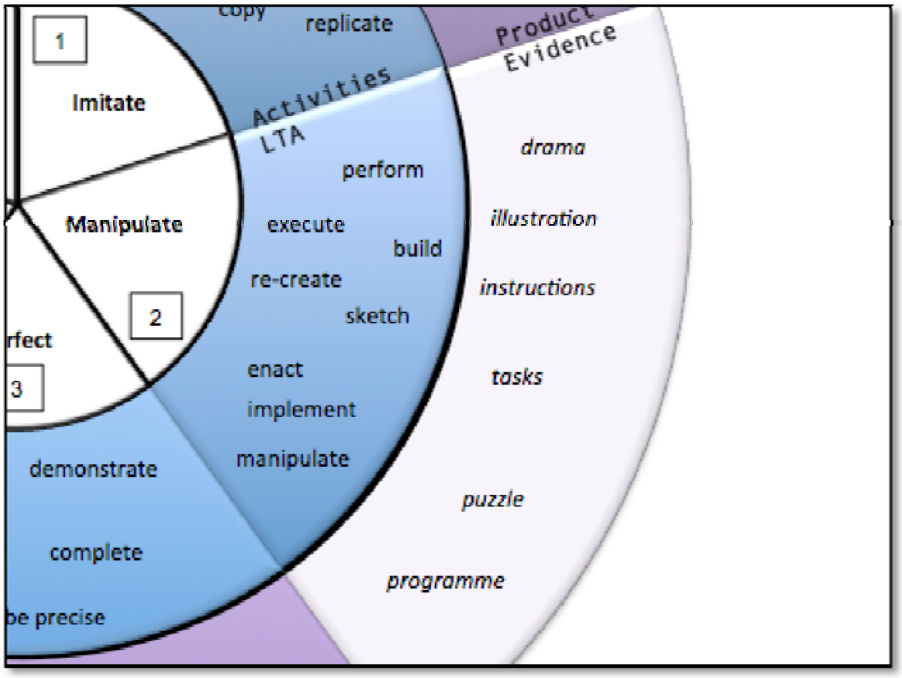


The circle is advocated as an effective way of visualizing the interconnected nature of the domains and associated activities and evidence forms. However, research within science education in particular has demonstrated the effectiveness of visual representations for comprehension of concepts but not without caveats regarding the cognitive load differences between novice and experienced users of different representational forms. Learners have a finite 'working memory' and, as such, individual preferences for shape and colouration, prior knowledge of the forms and their possible metaphorical interpretations will all influence learners' cognitive structures and processes (Cook, 2006).

Figure 2 illustrates how this circular structure has been constructed. The proto-verb identified as appropriate to this level of study is *manipulate*, the ability to repeat or reproduce actions to a prescribed standard from memory or based on instructions. The ILO for this module might be phrased to the effect that by the end of the module the student will be able to '*manipulate* data sources and data search instruments to generate appropriate resources for primary research'. The proto-verb could equally be replaced with the active verb *execute* or *implement*. The important point is that during the module a student might be expected to engage in a range of 'active' tasks that support the proto-verb '*manipulate*'. They may be asked to *execute* a pre-defined search in an online database, or to work with peers to build a

series of research terms, to *implement* a cross platform search or re-create a search carried out in one system or another.

Figure 2 - Segment of Taxonomy Circles showing structure



The kinds of formative assessment tasks that would enable the student to evidence this action could be very varied indeed. In the example given, there is likely to be an emphasis on the 'task' itself and the evidence of output. However, different psychomotor actions might generate a computer programme, a manual of instruction or a diagrammatic instruction. In the example given, one can imagine asking students to evidence the ability to manipulate an industry standard search tool by authoring an instruction manual for others, for example, using specific examples.

It is important to stress again that neither the active verbs nor the product evidence given are prescriptive lists. Quite the contrary, there is every expectation that a module design team will debate, argue and personalize the taxonomy circles for their discipline and context. The outmost circle represents a range of creative assessment forms that can be used as evidence. Their acceptability to examiners, professional bodies and accreditation bodies will depend, of course, on the context in which the learning designer is operating. They are, however, intended to challenge assumptions regarding current assessment and invite designers to consider not only a different approach but also perhaps alternative forms. In the example in Figure 2, a student who had an acknowledged learning difference might be asked to create a visual illustration of processes rather than write instructions. The module team could still be confident the proto-verb was being evidenced

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Figure 3 - Cognitive Domain as a Taxonomy Circle

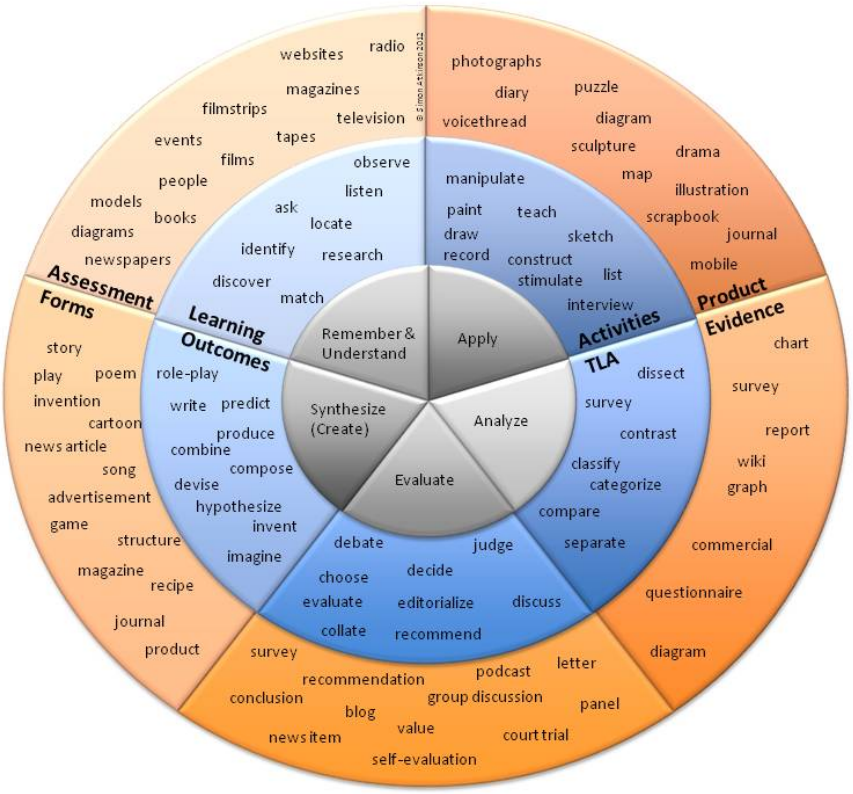


Figure 4 - Affective Domain as a Taxonomy Circle

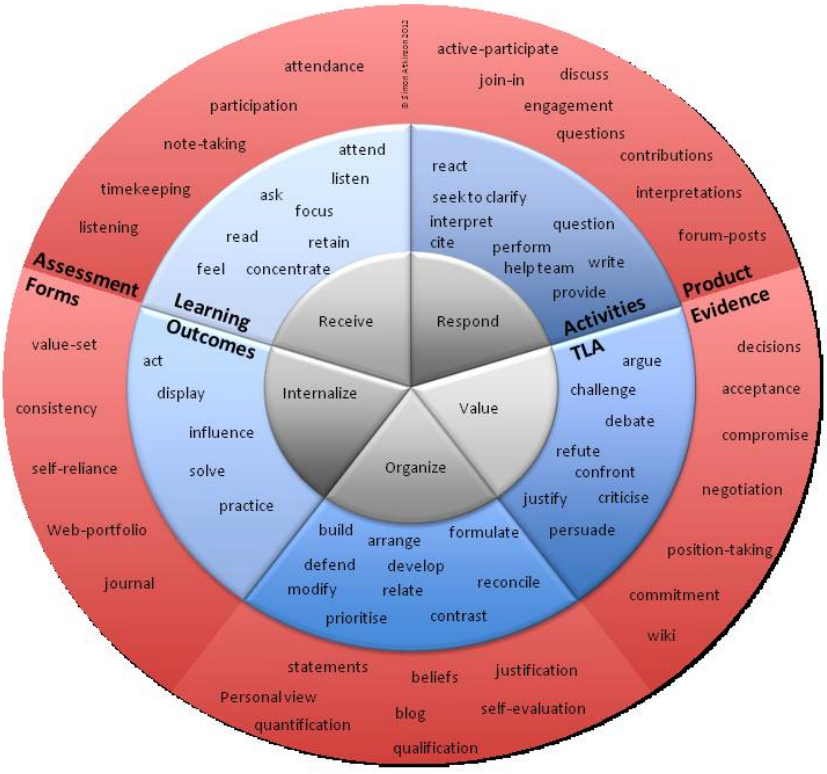


Figure 5 - Psychomotor Domain as a Taxonomy Circle

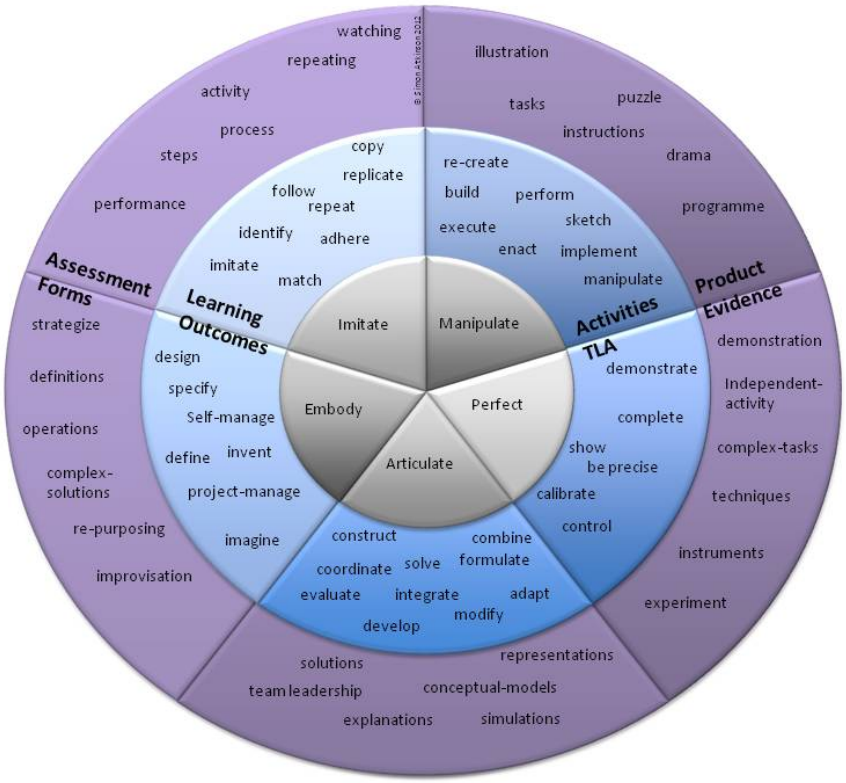
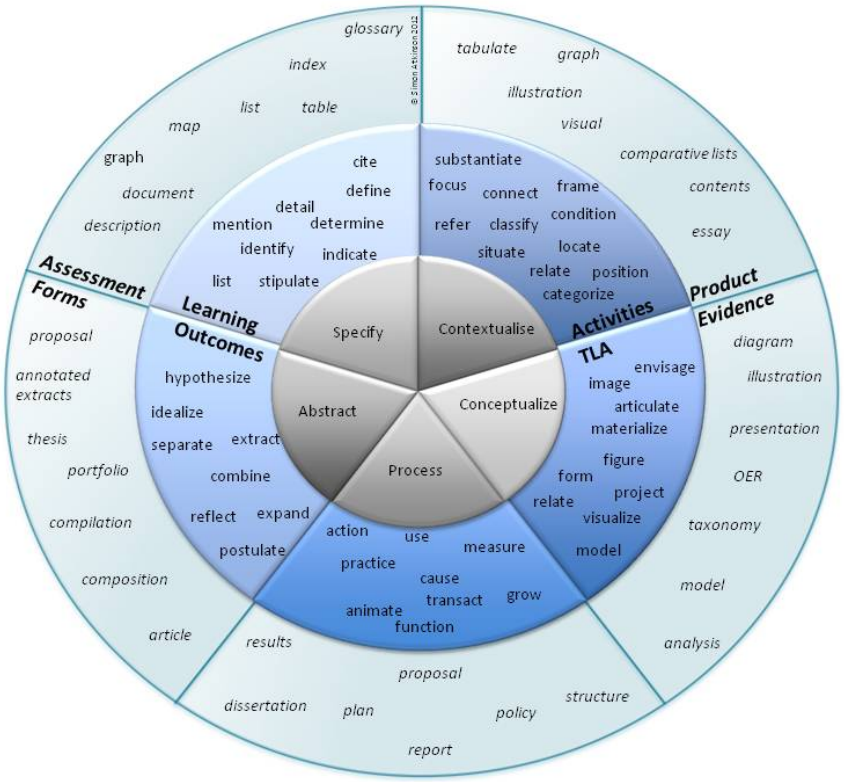


Figure 6 - Subject Domain as a Taxonomy Circle



WRITING MODULE INTENDED LEARNING OUTCOMES USING TAXONOMY CIRCLES

The intention of the taxonomy circles is to facilitate the learning design process. Individuals or course teams may choose to work from a defined activity and explore its 'root' active verb to establish relationships to a specified learning outcome, or they may work in reverse. Having established the ILO or learning and teaching activity (LTA) that evidences it, they may then choose to explore the outer most circle which suggests the evidence forms, or assessment types. None of the active verbs used to define the ILO/LTA are 'fixed' and the assessment/evidence is expected to change and evolve (particularly where technology forms are specified) but the tool serves as a dynamic canvas on which a design team can explore balance, incremental relationships and depth of assessment forms.

The process is not envisaged as an automated or pre-determined one. Rather, course design teams are expected to come together and negotiate the pattern of ILOs in their module, map these to topic or weekly objectives and to seek as many different engaging and creative ways as possible of engagement students in LTA that rehearse the ILO.

The circular representations of the domains and associated taxonomies also serve to make learning designers conscious of the language they use. Can a verb be used at different levels? Certainly. Why? Because context is everything. One might identify different rock samples in a first year geology class as part of applying a given classification of rocks to samples, or one might identify a new species of insect as part of postgraduate research programme. The verb on its own does not always denote level.

FUTURE RESEARCH DIRECTIONS

There are three principal areas of future research in the use of these taxonomy circles.

The first is development of the taxonomies themselves, the way the verb is being used, and the associated activities and technologies used to demonstrate it. Constant revision of these details will ensure an enduring relevance to practitioners. It is anticipated that these taxonomy circles will prove valuable tools for educational development workshops with course design teams and provide a focus for debate and discussion.

The second area of development is in the application of relationships between the intended learning and the associated instrument or activity and the way in which these relationships may be articulated, such that they can be manipulated by adaptive learning environments. The ability for a system using advanced learning analytics to identify that an outcome has not been evidenced through a particular activity may seek to present the learner with the same outcome but through a different activity, exploring as it does the learner's different intelligences (Gardner, 1993) and learner preferences.

A third area of research, taking the notion of visualisation one step further, is the representation of these taxonomy circles to students themselves to illustrate progression and achievement. The idea is that each wheel represents a dial which may be coloured in to varying degrees in order to represent different levels of attainment. Placing each of the four circles together, illustrating varying degrees of engagements with each of the psychomotor, effective, cognitive, and knowledge skill sets may provide an alternative visual illustration to students in the form of a dashboard or advance organizer.

CONCLUSION

Increases in technology-supported learning, notably the move towards adaptive learning systems in which individual learner's action will generate an individualized learning pathway for future activity, will require a greater degree of design coherence within educational programmes. Coherent learning and teaching designs that genuinely enable the learner to evidence attainment of pre-defined learning outcomes, at topic or module level, and diverse assessment forms that reflect contemporary employment needs, will become key differentiators for institutions.

Intended learning outcomes provide a mechanism, if applied properly, to ensure that learners are not only encouraged to encounter ILO in a multitude of forms, but also that the evidence of doing so is varied and contemporarily meaningful. Coverage of all four domains, knowledge and understanding (subject domain), intellectual skills (cognitive domain), professional and practical skills (affective domain) and general transferable skills (psychomotor skills), would enable the student to consciously establish a picture of their abilities and to identify future learning needs. Because these alternative visual formulations of the four domains are well-structured and well-documented they will not only promote faculty engagement with coherent designs but also enable future adaptive learning scenarios and student-centred learning planning tools to be effective.

The lists of 'cognitive' verbs used by faculty when completing module specification templates from their quality office colleagues is no longer an adequate engagement with the learning design process. Faculty must develop a more comprehensive understanding of constructive alignment, ILO structures and the diverse forms of evidence possible if university education is to remain flexible, relevant and adaptable to the challenges of the contemporary knowledge environment.

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