

Quantifying and Assessing Learning Objectives

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Abstract

A number of studies have been conducted which use the Bloom taxonomy to improve teaching and learning. However, to our knowledge, neither the Bloom taxonomy nor any other established learning taxonomy has been used as a basis to develop a quantifiable tool that will enable teachers to analyse the cognitive process embedded in the objectives and assessment of a subject, as well as provide a methodology to assess alignment of those objectives with the assessment tasks.

This paper presents the development of such a quantifiable tool. We discuss the assumptions, method and potential benefits of the outlined approach and in particular its value in providing a mechanism for comparison between subjects, both over time for a given subject and between subjects. The approach has been applied to a specific example in the education system of a profession, the Institute of Actuaries of Australia.

The approach is not mathematically difficult to develop. The model requires a number of parameters to be specified. Once these parameters are specified then the methodology is robust. Adjustments to results are made by explicit adjustments to the parameters and not the methodology. A key consequence of this is that once the methodology is accepted, results and any changes can be explicitly tracked and the causes unambiguously identified. In environments where subjective opinion may be pronounced, such an approach raises the level and quality of discussion significantly - from 'shooting the messenger' to 'addressing the message'.

We also comment on the potential for extensions of this work.

In an economic and educational environment where teachers are being held more accountable for the attainment of promised learning outcomes for their students the development of the tool proposed here is potentially powerful and widely applicable.

Keywords: learning outcomes, evaluation, classification of skills, accountable educational outcomes, quantification of skills assessment, higher order skills.

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1 Introduction

The purpose of this paper is to outline a methodology that permits an explicit measurement of learning objectives and assessment methods within a subject. The learning objectives from an input or syllabus perspective can be evaluated to determine whether they describe the level of learning sought by subject providers. Similarly the outcome or assessment methods for the same subject can be evaluated against the learning outcomes to determine if they have been set to meet the syllabus objectives. The strength of this approach is that a structured and measurable assessment can be made on the quality of the subject documentation.

It therefore provides an objective basis on which to make judgements about key features of a subject and determine to what extent they are appropriate and aligned with the assessment. If there is disparity the methodology quantifies the extent and supports determining a solution to address the problem.

The tool is therefore a potentially powerful management tool for supporting subject development and provision. A key strength of this approach is that it reduces uncertainty and differences of opinion about the design of course outcomes and assessment amongst stakeholders and provides a common methodology for discussing and determining learning and assessment outcomes. Further, it provides a tool for introducing and evaluating the impact of changes within a subject.

As a general comment, we observe that the use of a clearly defined and structured methodology provides a constructive route to resolving evaluation issues. Once the methodology has been established, discussion regarding how results can be changed becomes directly managed by making specific and explicit changes in the input parameters. The removal of debate as to how results were determined can then be avoided. The focus of discussion is then drawn to a higher level of the changes required in input parameters to achieve desired goals. To draw an analogy, consider the methodology as a messenger providing information regarding the measurement of learning objectives and assessment methods. Having a defined methodology with a clear set of inputs allows discussions to be more focussed on 'addressing the message' rather than 'shooting the messenger'. The ability to both document and reproduce results is also of clear value.

We note that the methodology focuses on the documented aspects of subject provision and does not extend to how a course is delivered. The approach outlined here is an educational evaluation tool focussing on the key components of syllabus and assessment.

It is clear that more variables than syllabus and assessment impact on student results in a subject. However, if student results are not as expected then a key consideration is to evaluate the extent to which assessments and the learning methods supported stated subject outcomes. By having rigorously applied the methodology to the subject outcomes there is a useful quantifiable standard against which to "measure" the appropriateness of learning processes and assessment methods and determine whether they were pitched at an appropriate level. The proposed methodology provides numerical values to different levels of learning within a subject syllabus and so one can measure the subject assessment methods against the outcomes to see if they are at the same numerical level. If not it is likely the assessment methods were too hard or too easy to accurately assess a student. More particularly one can move into evaluating particular assessment items in an examination to determine how appropriate it was to the stated subject requirements. So if student results are not as expected the proposed methodology provides an objective tool for both analysing and addressing some key questions. If there is not a disparity between what the subject expects and what the students were examined on then the way is cleared to consider other educational issues that may be impacting on student performance.

In particular, it is noted that the issue of whether the approach underpinning the model is 'correct' or not is not the primary issue, rather the primary issue is providing insight into whether, based on the suggested methodology, the relative differences between intent and outcomes can be managed, monitored and addressed in an impartial manner. That is, the key contribution made with this approach is not based on its 'correctness' (or otherwise) but in its facility to measure relative differences – between syllabus objectives and assessment outcomes.

The change in paradigm from 'correctness' to 'comparison' is important and provides a strong practical management tool for those responsible for the provision of education and needing to demonstrate that stated course outcomes are demonstrably met.

The approach also allows comparisons of a course to be made over time. Given, as we argue, course outcomes and assessment methods can be quantified as having numerical values then it is possible and highly valuable to be able to track course standards over time to ensure parity of standards over delivery cycles/years. If changes are made to the course, say because of new professional standards or fields of practice, syllabus objectives and assessments can be monitored to ensure the same standard of course outcomes and assessment are maintained despite content changes.

While the Bloom taxonomy provides a very useful model, we acknowledge that the categories are not absolute, nor discrete. In addition, we are mindful that the categories are not objective entities but are a way of describing skills which are embedded within the subject content and assessment practices of the discipline in question. Thus despite

possible weaknesses of the taxonomy, it provides a useful model for describing, categorising and hence comparing cognitive skills.

The structure of the paper is as follows. The next 3 sections put the work into context from several perspectives:

- **Background.**
- **Literature Review.**
- **Bloom Taxonomy.** This includes a brief description of the six levels of learning.

The following sections discuss the development of the methodology for assessing a subject:

- **Defining Key Words.** These key words are then used as ‘code word’ to characterise the expected level of learning.
- **Quantifying the Approach.** We outline the parameters needed to allow a quantification of the overall level of learning expected.
- **Overall Subject Intended Learning Level.** We put the overall levels of learning observed into a more general context.
- **Specific Example – Results for Actuarial Practice & Control Review.** We demonstrate the application of the methodology in a specific instance. A number of Appendices illustrate this application in details and could be used as templates for further work. The focus in this example should be on the mechanics described and not on the specifics of specific work discussed.
- **Further Applications of Methodology.** In particular we note the methodology can also be applied to assessment materials for a subject. This provides a clear way in which the question of whether what was promised has been delivered can be measured. As such the applications of the methodology provides valuable educational management tools.
- **Further Work.** We note some areas in which further work is being pursued.
- **Conclusions.**

2 Context and Background

This work was initiated in the context of an Institute of Actuaries of Australia (IAAust) review of the syllabus for the Part II of its professional education – the so-called Actuarial Control Cycle - requirements. One of the authors, Jules Gribble, chaired this review and prepared the report of the review. One of the authors, Lois Meyer, also provided support for this review. The contribution of the members of the committee for the review is acknowledged, Gribble et al (2001).

The primary focus of the IAAust review was on the content of the required syllabus for the Part II of the IAAust educational requirements. However, an important aspect of the work done to support the review was to seek a methodology that permitted a comparison of the then current syllabus with the recommended revised syllabus. The view taken was that if such a methodology was not considered and made explicit then there would be no basis on which a rational and constructive discussion of the impact of recommended changes could be built.

The approach is not mathematically difficult to develop. The model requires that a number of parameters be specified. Once these parameters are specified then the methodology is robust. Adjustments to results are made by explicit adjustments the parameters and not the methodology. A key consequence of this is that once the methodology is accepted, results and any changes can be explicitly tracked and the probable causes identified.

The recommendations with regard to revising the syllabus for Part II made in the report Gribble et al. (2001) were not accepted in their entirety by the IAAust. The recommendations made in this report are included in this Report, in the context of providing an example of the application of the methodology. Although not directly relevant to this paper, it is noted that the final syllabus adopted by the IAAust can be obtained from the IAAust website, IAAust (2002).

For reference, we briefly put the IAAust Part II subject into context. Denoted by the IAAust as the 'Actuarial Control Cycle', the subject is taught on behalf of the IAAust by accredited universities in Australia. As at December 2002 there were four such universities, Australian National University, Macquarie University, University of Melbourne, and University of New South Wales. The material is taught as two consecutive single semester honours subjects through the Centre for Actuarial Studies at the University of Melbourne.

Although it is not directly relevant to this paper, note that a fuller discussion of the objectives and underlying philosophy for 'Actuarial Practice and Control' subjects is provided in Gribble (2003).

3 Literature Review

In higher education there is much discussion of the need to teach students the higher order cognitive skills (analysis, synthesis, evaluation and critical thinking). These skills are assumed to be important, yet there appears to be no systematic way of analysing the cognitive skills outlined in subject objectives and assessment tasks. Since the Dearing report (1997) there is a recognition of the need for students to develop skills such as critical thinking, evaluation and problem solving in order to prepare them for life

beyond the academy. This is particularly relevant in the context of the specific example we consider where there is a need to demonstrate that learning tasks and assessment include higher order thinking in order to prepare students for a professional role.

Recent studies into higher education have emphasised the connection between the ways in which teachers conceptualise teaching and the ways in which students approach their learning (Kember & Gow, 1994; Ramsden & Entwistle, 1981; Trigwell, Prosser, & Waterhouse, 1999). This is significant, in the context of this study, because the way in which a teacher conceptualises the subject should be reflected in the aims, objectives and assessment tasks. Much of the research into approaches to teaching/learning in higher education provides valuable insights into student perceptions of their learning experience or teacher perceptions of their own teaching orientations (cf Marton, Hounsell, & Entwistle, 1997). However, what is needed, to enrich this research, is a systematic means of examining the objectives and assessment tasks in particular subjects to more fully understand the kinds of learning skills required and whether these are actually tested.

Studies have pointed to the need for alignment between teaching and assessment (Anderson, 2002; Biggs, 1999; Ramsden, 1997). As Ramsden (1997) points out, students' approaches to learning are affected by their perception of how the work will be assessed. For this reason, effort must be made in subject planning and in the setting of assessment questions to ensure that students are learning what we want them to learn. Similarly, Anderson (2002) points to the importance of a strong alignment between objectives and assessments, between objectives and instructional activities and between assessments and instructional activities in order to ensure curriculum alignment. In many subjects, such as those in actuarial education, there is a need to ensure that the skills taught move from knowledge and comprehension, though to the higher order skills. Hardy, Dickson, & Paterson, (1990) point out that the work of practicing actuaries requires higher order skills, however these are not always taught and may not be tested fairly in a traditional exam. Thus there is a clear need to examine the level of learning, whether we are teaching the higher level skills, whether subjects become increasingly sophisticated and whether objectives, teaching materials and assessment are aligned.

Recent research into differences into disciplinary cultures has drawn a distinction between 'hard' and 'soft' disciplines. Hard disciplines are those with well established paradigms and are often quantitative in nature (Becher, 1989; Biglan, 1973a, 1973b; Donald, 1995). These disciplines (actuarial education being one example) tend to conceptualise knowledge as linear and hierarchical and hence built up sequentially. This means that in these areas, much of the curriculum (at least until the more advanced stages) is comprised of "established facts and demonstrable theories, rather than uncertainties and relativities" (Neumann, Parry, & Becher, 2002:407). This means the tool outlined in this study will be useful in examining the sequential development of

skills in subjects in actuarial education and similar subjects. It is worth considering that different disciplines understand the structure of knowledge differently. So this tool would not be used with the assumption that all disciplines should necessarily follow the same pattern. As Lattuca & Stark (1994, 1995) point out, soft pure fields excel in developing students critical thinking skills. So it needs to be borne in mind that different disciplines may develop higher order skills at differing rates.

James, McInnis, & Devlin (2002) argue that there is a need for explicit mechanisms for measuring and articulating the learning outcomes expected in higher education. They point out that there are few objective reference points for examining the intellectual standards of Australian degrees and that there are few formal processes for monitoring standards. Integral to achieving this is a means of measuring and reporting on student knowledge, skills and performance. The development of a mechanism for discussing standards cannot occur without dialogue within disciplines (James et al., 2002). This study is an important step towards opening up the debate, initially within one particular subject but ultimately broadening it within the actuarial discipline and ultimately extending the debate to other fields.

Bloom's taxonomy (Bloom, Englehart, Furst, Hill, & Krathwohl, 1956) is a widely used means for identifying the cognitive skills used in teaching and assessment. However, while it has been used in a number of settings, it has not been used as the basis for developing a systematic tool to objectively evaluate in a quantifiable way the level of skills in the objectives or assessment and as a means to analyse the alignment between the two. Bloom's taxonomy provides a classification of levels of cognitive skills or processes, which build upon one another. As the taxonomy provides a detailed vocabulary for articulating the sophistication of skills taught and the match between expectations and instruction (Nodrvall & Braxton, 1996) it is a useful means of defining academic quality by focusing on the subject-level processes.

Bloom's taxonomy has been extensively researched and found to be useful across different means of instruction, age and subject (Kottke & Schuster, 1990; Kunen, Cohen, & Solman, 1981). However, some doubts have been raised about the validity of the taxonomy regarding the categorisation of items into a particular level of the hierarchy. In addition, questions have been raised regarding the ranking and independence of analysis, synthesis and evaluation. (Nodrvall & Braxton, 1996). The taxonomy has also been questioned regarding its accuracy in identifying the cognitive processes used by students (Gierl, 1997). Yet despite these questions, it is widely agreed to be a very useful means of understanding learning outcomes.

In recent years there have been revisions of the taxonomy (Krathwohl, 2002). However, while the revised version has restructured the categories and added a metacognitive element (Pintrich, 2002), it largely remains true to the original version.

A number of recent studies have been conducted which use the taxonomy to improve teaching and learning, for instance in educating academic staff in test construction (Evans, 1999), improving literature reviews (Granello, 2001), assessing multiple choice examinations (Knecht, 2001), assessing higher order skills (Sanders, 2001), examining the education of actuarial students (Hardy et al., 1990) and to develop a parallel system in economics education (Hansen, 2001). In addition, it has also been used for defining academic quality (Nodrvall & Braxton, 1996).

However, to our knowledge, the taxonomy has not been used to develop a quantifiable tool that will enable teachers to analyse the cognitive processes embedded in the objectives and assessment of a subject and the alignment of objectives with assessment tasks.

To move forward, in the next section we provide a brief summary of the Bloom taxonomy and its levels of learning.

4 The Bloom Taxonomy

In 1956, Benjamin Bloom headed a group of educational psychologists who developed a classification of levels of intellectual behaviour important in learning. His work is commonly referred to as the Bloom Taxonomy. See Bloom et al (1956).

The major idea of the taxonomy is that what educators want students to know (statements of educational objectives) can be arranged in a hierarchy from less complex to more complex. In general, research over the last 40 years has confirmed the taxonomy as a relevant hierarchical description of learning. There has been some debate about whether synthesis and evaluation are equally complex, but there is agreement that these two levels require sophisticated cognitive skills and are more difficult than the other levels.

For each level in the hierarchy, Bloom provided illustrative verbs that indicated the learning outcomes expected at this level. For basic fact learning one would expect a student on successful completion of a subject to demonstrate their factual knowledge by listing or stating some particular learnt information. However in a different subject or a different part of the same subject one might expect the student to demonstrate synthesis of complex principles and data and application of judgement. In such circumstances the Bloom taxonomy provides some illustrative verbs of the type of behaviour one would expect to see demonstrated. It is by looking at these levels and illustrative verbs that one can begin to clearly describe and reach some agreement about just what level of learning is expected to be taught and assessed within a subject.

4.1 Bloom Taxonomy Learning Levels

A brief description of the six levels in the taxonomy learning levels is provided.

- **Knowledge:** Knowledge is the remembering of previously learned material. This may involve the recall of a wide range of material, from specific facts to complete theories, but all that is required is the bringing to mind of the appropriate information. Knowledge represents the lowest level of learning outcomes in the cognitive domain.

Examples of learning objectives at this level are: know common terms, know specific facts, know methods and procedures, know basic concepts.

- **Comprehension:** Comprehension is the ability to grasp the meaning of material. This may be shown by interpreting material (explaining or summarizing), and by estimating future trends (predicting consequences or effects). These learning outcomes go one step beyond the simple remembering of material, and represent the basic or core understanding.

Examples of learning objectives at this level are: understand facts and principles, interpret material, interpret numerical data, translate verbal material to mathematical formulae.

- **Application:** Application refers to the ability to use learned material in new and concrete situations. This may include the application of such things as rules, methods, concepts, principles, laws, and theories. Learning outcomes in this area require a higher level of understanding than those under comprehension.

Examples of learning objectives at this level are: apply concepts and principles to new situations, apply laws and theories to practical situations, solve mathematical problems, and demonstrating the correct usage of a method or procedure.

- **Analysis:** Analysis refers to the ability to break down material into its component parts so that its organizational structure may be understood. This may include the identification of parts, analysis of the relationship between parts, and recognition of the organizational principles involved. Learning outcomes here represent a higher intellectual level than comprehension and application because they require an understanding of both the content and the structural form of the material, and the ability to look behind the facts and assumptions.

Examples of learning objectives at this level are: recognize unstated assumptions, recognise logical fallacies in reasoning, distinguish between facts and inferences, identify the relevancy of data.

- **Synthesis:** Synthesis is the ability to put parts together to form a new whole. This may involve the production of a unique communication, a plan, or a set of abstract relations (scheme for classifying information). Learning outcomes in this area stress creative behaviours, with major emphasis on the formulation of new patterns or structure.

Examples of learning objectives at this level are: ‘propose a plan for ...’, integrate learning from different areas into a plan for solving a problem, ‘formulate a new scheme for ...’.

- **Evaluation:** Evaluation is to do with the ability to judge the value of material for a given purpose. Learning outcomes in this area are highest in the cognitive hierarchy because they contain elements of all the other categories, plus conscious value judgments based on clearly defined criteria.

In summary, we have:

- **Knowledge:** Student recalls or recognizes information, ideas, and principles in the approximate form in which they were learned.
- **Comprehension:** Student translates, comprehends, or interprets information based on prior learning.
- **Application:** Student distinguishes, classifies, and relates the assumptions, hypotheses, evidence, or structure of a statement or question.
- **Analysis:** Student breaks down material into components, understands organisational structures and the relationships parts.
- **Synthesis:** Student originates, integrates, and combines ideas
- **Evaluation:** Student appraises, assesses, or critiques on a basis of specific standards and criteria.

5 Defining Key Words

Without losing generality, we shall assume that the syllabus for a subject is structured as follows:

- **Units:** These comprise a group of one or more Aims. Units are essentially useful administrative groupings of Aims.
- **Aims:** These comprise a number of objectives.
- **Objectives:** These are the basic building blocks of the syllabus.

Examples of Units, Aims and Objectives are in the example detailed in the Appendices.

Key to assessing of the learning outcome for each Aim or Objective is that the desired levels of learning are clearly specified to all stakeholders involved. In particular the major stakeholders directly involved are the education providers, the education receivers, and the education sponsors.

To permit this, we choose a specified a set of key words and explicitly and specifically allocated them to the various levels of learning outcome. Clearly, it is necessary to ensure that no key word is assigned to more than level of learning. A consequence of this is that words that may, in general usage, have differing meanings for different people, become specifically defined by taking on an additional attribute in that they denote a requirement for a specific level of learning as driven by the Bloom taxonomy. In this sense the key words become specialised though this additional criteria, and may, for some people, cease to have their usual colloquial meanings. This is quite consistent with the specialised meanings that many words take on in specific academic contexts relative to their general usage.

The specific set of words chosen for a particular subject to convey the level of learning expected may vary. To make the approach more concrete, we include the list of the key words agreed to be used in Gribble (2001). This list is similar to those found in a number of texts on Bloom's taxonomy. In that context, the selected words place emphasis on being able to apply knowledge to problems – an active orientation rather than an observer/passive orientation. However, while this list may be useful, it is not claimed that it is definitive or complete.

Table 5.1: Bloom Taxonomy Key Words

1 Knowledge	2 Comprehension	3 Application	4 Analysis	5 Synthesis	6 Evaluation
Define List State	Describe Discuss Explain Express Identify Illustrate Outline	Apply Demonstrate Estimate Extrapolate Generalise Interpret Relate Use Value	Analyse Calculate Categorise Classify Compare Conclude Contrast Detect Differentiate Discriminate Distinguish Determine Evaluate Examine Predict Question Recognise Select Solve Test	Construct Deduce Delineate Design Develop Formulate Modify Plan Prepare Produce Propose	Appraise Argue Assess Choose Consider Decide Judge Justify Review Revise Validate

6 Quantifying the Approach

We now seek to quantify the overall assessment of the desired learning outcomes after utilising the Bloom Taxonomy.

Step 1 – Numerical Rating for Bloom Taxonomy: The first step in this process is to allocate numerical ratings to each of the 6 levels of learning of the Bloom Taxonomy.

We have done this as follows:

Knowledge	1
Comprehension	2
Application	3
Analysis	4
Synthesis	5
Evaluation	6

We discuss the choice of these numerical ratings later.

Step 2 – Allocate Learning Levels to Aims and Objectives: The second step in the process is to allocate the appropriate level of learning to each of the Aim and Objectives. This is where the importance of utilising the specific set of key words becomes apparent. Note that we do not extend the approach to include Units, although in principle this is straightforward.

We discuss the allocation of the learning levels later.

Step 3 – Determine Weightings for Aims and Objectives: The third step in the process is to identify the relative importance of each Aim and then, within each Aim of each Objective. This provides a weighting to be attributed to each Aim and Objective.

We discuss the allocation of weightings later.

Step 4 – Compute Aggregate Results: A good tool for this is a spreadsheet – for example a Microsoft EXCEL spreadsheet. For clarity, documentation and flexibility care should be taken in the structure of the spreadsheet to ensure that all parameters are explicitly identified.

Step 5 – Review Results: The spreadsheet will produce a set of results at varying levels of detail. Then explicit assessments of the subject to which this approach is taken can be made. In particular, debates around sometimes subjective issues such as ‘this should be taught to a higher (or lower) level’ become much clearer. If it is desired to change a learning level, then there is now a clear process:

- Review current Aims and Objectives and their specified learning levels;
- Adjust the learning levels of existing Aims and Objectives;
- Add new or delete current Aims and Objectives;
- Review and adjust the weightings applied to each objective.

The results of these changes will then unambiguously emerge from the accumulation process. If the results are not as desired, then the process above can be repeated. Changes are made by changing the relevant parameters, not by changing the methodology. In this way an explicit record of changes is retained and the reasons can thus be identified. Note that once the computational tool (the spreadsheet in this case) is properly built and tested it does not need to be changed. The only things that change are the values of the established set of parameters.

The mechanics of implementing this process are straightforward. We outline the computations for an Aim.

To determine the average level of learning for an Aim:

1. Determine the Total_Weight as the sum of the weight assigned to the Aim and those assigned to each of its constituent Objectives.

2. Two results are then computed:

$$\text{Aim_Objective_Level} = \frac{[\text{Aim_Level} * \text{Aim_Weight} + \text{Sum of Objective_level} * \text{Objective_Weights}]}{\text{Total_Weight}}$$

$$\text{Objective_Level} = \frac{[\text{Sum of Objective_level} * \text{Objective_Weights}]}{\text{Sum Objective_Weights}}$$

The extension of the approach to either a Unit (a set of Aims) or a full subject (a set of Units or a full set of Aims) is analogous. An overall result can be determined by extending the Aim_Objective_Level computation above. The average over the objectives of more than one Aim is the extension of the Objective_Level computation above. An average over a set of Aims (only) can be determined by the analogy of the Objective_Level computation above (replacing the word Objective with Aim).

In this way aggregate results, culminating in subject averages, are obtained.

6.1 Numerical Rating for Bloom Taxonomy

In considering the numerical ratings proposed above – the 1/2/3/4/5/6 scale – we note this choice was made on a basis of convenience.

We make several observations:

- If the rating scale is uniformly increased by an integer – for example by 10 so a 11/12/13/14/15/16 scale is used - then the arithmetic of the computations implies that results will simply be increased by that integer - in this case 10.
- We have explicitly chosen to have the numerical gap between consecutive ratings be constant – in particular 1. While choosing different gaps is clearly possible, we can see no advantage in doing so, and note that the relativity of the aggregate weighted results compared to the chosen scale will be unaffected by the specifics of the choice of the scale.

In particular, and importantly, we emphasize the purpose of the methodology is to provide a robust mechanism that can be used to make a relative assessment of the overall learning level of a subject. By the term relative we mean that our primary purpose is to provide a mechanism that is able to reflect change in an unambiguous and structured manner – so that changes in the overall levels of learning can be measured and their sources identified. This purpose can be considered to be separate and

independent of whether an assessment of levels of learning are 'correct' by some absolute measure.

We consider that in the context of assessing the relative levels of learning for a given subject that the 1/2/3/4/5/6 scale we have used thus contains valuable information. However, see our further comments in the section on Further Work.

6.2 Allocation of Learning Levels

We accept that there is some judgement required in making a choice or an assessment as to the levels of learning of Aims and Objectives.

In subject development, our methodology provides a process by which the intended learning levels for each Aim and Objective is explicitly determined. In general such a determination may be made by an individual, or in a more general context utilise a Delphi approach.

Our strong recommendation is that when a syllabus is specified, that the agreed numerical ranking for the intended level of learning for the Aim or Objective be included, together with text describing the Aim or Objective, as an integral component of the syllabus. This is clearly a simple step to take once the level of learning has been explicitly chosen.

A clear advantage of such an inclusion would also be that when other than those directly involved in the setting of the syllabus become involved in the teaching of the materials there would be clear and explicit guidance as the intended level of learning. Further, with some explanation, students could also be expected to have a clear understanding of the required level of learning expected.

When an Aim or Objective uses learning verbs taken from the taxonomy to specify the behavioural level of learning to be demonstrated the whole aim needs to be considered in assessing the overall level of learning required. For example, that the desired outcome is that the student will be able to '*explain*', it is understood to be a Level 2 outcome. Comprehension and understanding are expected to be demonstrated. If, however, the aim asked for the student to be able to '*explain and justify* ...' the level of learning to be demonstrated is higher and more sophisticated.

The methodology described here provides a mechanism for clarifying the intended level of learning. It removes the ambiguity and differences of opinion inherent in the use of common words by having a specific set of words take on an additional attribute of representing a requirement for a specific level of learning as driven by the Bloom taxonomy.

We note that it is perhaps to be expected that the learning levels attributed to Aims may be higher than those attributed to the individual Objectives, as the Bloom Taxonomy methodology expects that a synthesising process will take place in moving from the more 'micro' level of the Objectives to the more 'macro' level of an Aim.

6.3 Weightings

There is scope for flexibility in terms of the weightings assigned Aims and Objectives. A reasonable approach would seem to be to relate the weighting to the emphasis the Aim or Objective is given in the subject. This could well be measured in terms of the amount of time attributed, for example as measured in terms of lecture time allocated, to the Aims or Objective.

In the longer run it is hard to see a justification for assigning a higher or lower weighting to an Aim or Objective than one consistent with the teaching effort put into communicating that Aim or Objective.

We also note that while Aims are made up of Objectives, we have specifically given both the Aims and Objectives weightings. The reason for this resides in the earlier observation that the Bloom Taxonomy methodology expects that a synthesising process will take place in moving from the more 'micro' level of the Objectives to the more 'macro' level of an Aim.

This is discussed further in the context of the specific application of the methodology reported on.

6.4 Assessing Results

We make some observations on how results can be interpreted.

As results are summarised, for example from the level of individual objectives to that of Aims, and then from that of Aims to a higher level (the overall subject or Units within a subject), the process of summarising loses information.

This loss of information needs to be recognised when comparison are made. For example if two objectives are equally weighted and have been assessed with learning levels of, say, 2 and 4, then the arithmetic average will be a learning level of 3. This should not be taken to imply that the two objectives could or should be replaced with two amended objectives, each with a learning level of 3.

There are clearly other important criteria which need to be applied in the design of a curriculum, such as the appropriate order and level of the introduction of new knowledge relative to the extension and integration of existing (presumed) knowledge

and skills, and the appropriate coverage of subject matter. Such issues are not, nor are they intended to be, addressed by our proposed methodology. The primary purpose of our methodology is to provide a management tool – measuring the impact of changes made at the syllabus level, and to provide a mechanism whereby the assessment of the stated objectives can be evaluated.

A second numerical measurement which can be easily extracted from the numerical quantification of the learning objectives is that a measure of the spread of learning objectives in the syllabus can also be made. This can be done by computing the variance or standard deviation of the learning objectives relative to the summary ratings, which are averages. This measure of the spread of learning objectives can be used to gain further insight into the syllabus structure.

In general, the summary level of learning is a weighted average: $R = \sum w_i r_i$, where w_i is the assigned weighting, and r_i is the assigned learning level. A measure of spread can be found as $S = \sum w_i (r_i - R)^2$. The square root of S , SD , analogous to a standard deviation, would more likely be used as a standard measure of spread.

To give a simple example, assumed there are 4 learning objectives, each with the same weighting (of 1) for simplicity, with assessed learning levels of 2, 3, 3 and 4. This gives an average of 3.0, and a spread of 2. This is a very different result from when the four objectives have assessed learning levels of 1,1,5 and 5, which give an average of 3 still, but a spread of 16. The large size of this spread may well suggest that there are issues with the relativities of the assessed learning objectives.

Another expectation that may be held is that the distribution of the assessed learning levels of objectives is uni-modal. That is the majority of them are clustered about one value – typically around the average, R . In contrast a bi-modal distribution would have values clustered around two distinct values, as in the second example above. This generally may well be considered to be less appropriate.

Our methodology provides a quantification of the measured aspects of the distribution of learning levels without specifically commenting on their appropriateness. That is, it is a mechanism for raising important questions, but does not, and cannot, provide educational solutions. That is, our methodology provides a tool to improve educational outcomes and assessments.

7 Overall Subject Intended Learning Levels

A key issue in assessing the results of applying the methodology is a measure of a reasonable level of learning to be expected from the subject. We are not aware of any other work that has been conducted in this area, and so there is very little basis for assessing such levels.

However, in the joint context of both professional actuarial education and the teaching of honours level actuarial subjects by the Centre for Actuarial Studies at the University of Melbourne, some initial thought can be formulated.

Some earlier work referring to the application of the Bloom Taxonomy in the context of actuarial education has been reported in Hardy et al (1990). Also, the IAAust has utilised the Bloom Taxonomy in reviewing and updating its Part III professional education syllabuses – albeit not attempting to apply a structured approach as proposed in this paper.

A review of the work involved with the IAAust Part III reviews and other considerations suggest that a reasonable overall level of learning for an Honours level subject is to have an Aims Only level as result in the region of 3.0 – 3.5 and the Objective Only average needing to be in the region of 2.5 – 3.0. This is based on the 1/2/3/4/5/6 scale we have used to represent the Bloom Taxonomy and the same weighting structure for Aims and Objectives as used in this paper.

The context of the IAAust professional actuarial education provides some experience to place the methodology proposed in this paper in a practical perspective. The Part III educational requirements of the IAAust, at least in the view of the IAAust, are at a level above that required of honours subjects, and may be more in line with the level of effort required for a Masters or other higher degrees. One of the authors of this paper, Lois Meyer, provided expert assistance to the IAAust during this work, which took place over the period of approximately 1996 to 1999.

A heuristic view is that the Part III subjects could reasonably be expected to have an overall level of learning for Aims of approximately 4.0 – 4.5 and an overall level of learning for Objectives of approximately 3.5 – 4.0. For the Part II subject with an overall level of learning for Aims in the range of approximately 3.25 – 3.75 and an overall level of learning for Objectives only of approximately 2.75 – 3.25. This result for the IAAust Part III subjects is supported by applying an analysis based on the keywords specified in section 4.1 to the Aims and Objectives for the Part III Life Insurance syllabus (IAAust 2001), in which the overall learning level of the Aims of 4.32 is considered appropriate for the Part III courses. This is consistent with the view

of Lois Meyer, who as previously noted provided expert assistance to the IAAust in their review of their Part III professional education subjects.

The slightly higher level of learning expected for the IAAust Part II professional education subject compared to an Honours level university subject is not unexpected given that the criteria for a student passing the honours level subject is expected to attain a higher level of marks in order to be recommended by the university delivering the subject for an exemption to give the student the opportunity to apply to the IAAust for recognition for achieving the Part II requirements.

Clearly, since these numbers are averages over a subject, there will be variation between various Aims and Objectives. The distribution of the Aims and Objectives around these benchmarks should be uni-modal and the variance should not be too large.

8 Specific Example: Results for Actuarial Practice & Control Review

The methodology described in this paper was initially developed to support an assessment to support the review of the Part II syllabus for the IAAust, Gribble et al (2001).

The process was applied as follows:

Step 1 – Setting Parameters: The parameters for the methodology were set.

Numerical Rating for Bloom Taxonomy: The 1/2/3/4/5/6 scale was used.

Allocation of Learning Levels: For the syllabus being reviewed the set of key words provided in Table 1 was used. For the syllabus to be developed, new Aims and Objectives were written with this same set of keywords to characterise expected levels of learning was utilised. Additionally, the numeric levels of learning intended was also specified.

Weightings: The following choices were made:

- The weighting for each Aim was equal to the sum of the weightings for the constituent Objectives;
- The weighting for each Aim was driven by the amount of lecture time allocated to that Aim. For convenience a scale of 5 point per lecture was used.
- In determining the weighting for each Objective, it was assumed that all Objectives were equally weighted within a given Aim.

Step 2 - Starting Point: The levels of learning, assuming the Bloom Taxonomy as described earlier, implied by the then current syllabus was assessed. It was accepted that this Actuarial Control Cycle syllabus may well have been written without reference to the Bloom Taxonomy and without reference to the specific set of keywords used in this report. Despite this, the assessment provided a basis from which to work.

Step 3 – Develop New Syllabus: Utilising a Delphi approach a new syllabus was developed and then assessed using the methodology. The details of the discussions and specifics of the content of the specific syllabus entries are not directly relevant to this paper.

The new syllabus was developed in a ‘bottom up’ manner, that is, each Aim and Objective was assessed in its own right and then after the process was completed the overall assessment was made.

To demonstrate the application of the methodology we include some of the results. Some are presented below, and further details are included as Appendices.

Appendix A: Proposed Syllabus - Actuarial Practice & Control. This includes the detailed proposed syllabus in a format which demonstrates both how the changes from the Incumbent syllabus were tracked, as well as all the weighting as explicitly recorded and the numerical learning levels attributed to each Aim and Objective. As such this is a prototype of a working document which can be utilised to manage to process of Syllabus review.

Appendix B: Numeric Assessment of Proposed Syllabus - Actuarial Practice & Control Learning Level. This provides the numerical summary which can be derived from the detailed syllabus as included in Appendix A. This provides an example of a summary management tool for the syllabus review process

Appendix C: Incumbent Syllabus - 2000 IAAust Actuarial Control Cycle Syllabus. This is provided to give context to the review process

Appendix D: Summary of Review of Part III – Life Insurance (IAAust 2000 Syllabus). This is provided to assist in putting the aggregate level of learning into context – as discussed above in section 7.

8.1 Summary of Changes in Syllabus

The Incumbent Syllabus to be reviewed had the following characteristics:

Incumbent Syllabus

		Learning Level						Weighted Learn Level
		1	2	3	4	5	6	
Units	6							
Aims	15	16	188	8	6	-	2	2.41
		7%	86%	3%	3%	-	1%	
Objectives	94	-	185	10	10	-	15	2.06
		-	84%	5%	5%	-	7%	

The sum of the weightings for each of the Aims and Objectives lines for the Incumbent Syllabus is 220 – the sum the entries under Learning Objective entries above.

So, the learning assessment measures, as described in Section 6.4 above can be summarised as:

Learning Assessment Measure – Incumbent Syllabus

	Average (R)	Spread (SD)
Aims	2.41	10.4
Objectives	2.06	16.7

The proposed new syllabus has the following characteristics:

Proposed New Syllabus

		Learning Level						Weighted Learn Level
		1	2	3	4	5	6	
Units	6							
Aims	18	-	-	120	110	20	-	3.60
		-	-	48%	44%	8%	-	
Objectives	108	-	79	135	35	1	-	2.83
		-	32%	54%	14%	1%	-	

Quantifying and Assessing Learning Objectives

The sum of the weightings for each of the Aims and Objectives lines for the Proposed Syllabus is 250 (the sum of the entries under the Learning Objective entries above).

So, the learning assessment measures, as described in Section 6.4 above can be summarised as:

Learning Assessment Measure – Proposed New Syllabus

	Average (R)	Spread (SD)
Aims	3.60	10.0
Objectives	2.83	10.5

The high concentration of the Aims and Objectives around the learning level of 2 in the incumbent syllabus is reflected in the Averages, but the impact of the outlying learning level 6 aims and objectives shows up in the SD's (standard deviations). The higher Averages from the Proposed New Syllabus show a more relevant level of learning in aggregate compared to the incumbent syllabus, and the more balanced structure of the Proposed New syllabus shows up in the lower SD's.

The change in cumulative weightings for Objectives in the Incumbent Syllabus compared to those for the Proposed Syllabus difference relate to the proposed changes in the syllabus.

As noted above, the Incumbent Syllabus may well have been written without reference to the Bloom Taxonomy and without reference to the specific set of keywords used in this report. Hence it is perhaps not appropriate to make a direct comparison between the two tables above. However, this in itself illustrates the critical need for precision and clarity in the specification of a syllabus to remove the potential for confusion as to the intended meanings the terminology.

In reviewing the results from this example the key elements to focus on are those which represent the implementation and structure of the approach, and not the specific details included.

9 Further Applications of Methodology

It is noted that the proposed methodology to characterise expectations for learning objectives has a number of advantages:

- ***Quantify Syllabus Development:*** In the context developing a syllabus particular context and more generally for actuarial education.
- ***Ongoing Change Control:*** In the context of reviewing an existing syllabus and quantifying the impact of proposed changes as they rise up to the aggregate learning level for the subject. That is, the methodology provides a mechanism which can be used for ongoing change control to syllabuses – whether the changes be small or large (evolutionary or revolutionary).
- ***Provide Mechanism for Assessment of Consistency Between Subject Offerings:*** By applying the methodology to a number of subjects, especially if they purport to teach the same materials but are taught by different institutions or departments etc, a clear assessment of the relative levels of learning objectives between the subjects can be made. Following from the next point, the equally important comparative assessment of the learning outcomes, in terms of evaluating the assessment materials can also be made.

9.1 Review of Subject Assessment

Perhaps more importantly, the methodology can also be applied to assessment materials for a subject – in particular to exams in the cases where the major component of assessment is by examination.

Since the key words are explicit, it would be relatively straightforward to form an impartial view as to the level of difficulty of exams etc by reviewing the key words used and the marks awarded, permitting a weighted average of learning outcomes to be assessed.

This provides a strong and relatively impartial management tool that would permit the question of where what was promised by the syllabus had been delivered in terms of the assessment materials. Such an approach may be of considerable value in the context of discussions regarding appropriate pass rates for subjects as it provides a measure of the requisite quality of the passes – in contrast to the numbers (relative or absolute) of such passes.

This approach has been utilised on a number of occasions by one of the authors, both in the context of assessment of exams for professional actuarial education and in the

context of the assessment of exams at the honours level at the University of Melbourne. In principle, the approach is very similar to that for assessing a syllabus. The exam materials are reviewed and an overall measure of the level of learning being requested in the assessment can be made by computing the weighted average of marks available according to the level of learning characterised by the key words used in the questions. Some judgement is required in comparing the aggregate level of learning as indicated by the syllabus and that indicated by the assessment aggregate level of learning. For example, it is not realistic to expect the weighting of Aims and Objectives in the assessment, especially in exams, to match that in the syllabus.

We leave aside the issues inherent in how the subject materials are taught.

10 Further Work

We note that there is nothing in the methodology described above which prohibits a further levels of aggregation. In particular, subjects at a given year level in a department could be aggregated and compared with those provided by other departments. This could be applied both between similar departments in different institutions and between less similar departments within a given institution.

The mathematics of such extensions is conceptually straightforward. We note, however, that from an administrative point of view the implementation of such a program would require careful data control and appropriate levels of security on the data base structure employed.

There are some obvious applications of such an extension to this work and some of them these are currently being pursued. In particular we note:

- As students move through a set of subjects of increasing difficulty, there is an opportunity to consider how comparative levels of learning can be developed to recognise the different starting points of students. Examples of such progressions include the progress through a university degree or through a professional education program leading to a professional qualification. This process would need to address the issue that as a particular student moves through the educational process a specific topic's learning assessment may be expected to change (declining, all other things being equal, and no enhancement or extension of knowledge being expected) with repeated exposure over time.
- There are some issues that need to be addressed in terms of comparability of subjects and whether the learning assessment evaluation applied to a given subject is based on an absolute or relative level. As an extreme example, a topic which is at a learning level of 6 for a primary school student is unlikely to

even be at a learning level of 1 for a university student. So the broad context in which the methodology is applied requires specification. In our example above it was clearly in the context of high undergraduate university education.

- The choice of the numerical ranking scale of 1/2/3/4/5/6 could also be investigated further. It may be that there are good grounds for considering a scale of the ilk of 1/2/3.5/5/7/7.5 could be considered. The rationale for such a scale lies in the idea that it is perhaps harder to progress from level 2 learning to level 3, than from level 1 to level 2 and so on. It can also be argued that the learning levels 5 and 6 are related by both being extensions from level 4 but being in a different dimension as well as requiring a higher level of skill and application.

We do note, however, that while adjusting the numerical scale may produce aggregate results which are more easily interpreted in the context of the underlying structure, that the key element of understanding the relative impact of changes in Aims or Objectives will be retained independent of the specific scale used

11 Conclusion

The primary objective of this paper has been outline an approach that can be used generally to quantify the overall expected level of learning, in accord with the established Bloom Taxonomy, for a given subject.

As a consequence of developing a robust numerical approach a number of additional benefits are immediately available. These include:

- Providing a potentially powerful management tool for the ongoing development and review of syllabuses;
- Providing a mechanism to assess whether assessment materials for a subject are consistent with the expected level of learning ‘advertised’ by the syllabus. Again this provides a potentially powerful educational management tool;
- Providing an opportunity, subject to further work, of assessing the relative levels of learning in groups or sequences of subjects. This again has the potential to provide a powerful tool for improving the integration of subjects and assessing subject equivalents, for example between different institutions.

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Appendix A: Proposed Syllabus - Actuarial Practice & Control

Actuarial Practice & Control: Detail Syllabus

INSTITUTE of ACTUARIES of AUSTRALIA
Part II: Actuarial Practice & Control Course
2001

31-Aug-01

UNIT	AIM	OBJ	New	Prior	Prior Adjust	DESCRIPTION	Learn Obj	Weight
1	1	A	1			Overview of Approach and Professionalism		
		B	1			Discuss and Apply an Actuarial Control Cycle in a Variety of Practical Commercial Situations	3	15.00
		C	1			Identify the elements of the Control Cycle and how the elements interrelate in an actuarial context.	2	3.00
		D	1			Demonstrate how the use of the Control Cycle can add value to the various stakeholders involved with resolving issues in financial services	3	3.00
		E	1			Demonstrate how the Control Cycle can be applied in specific situations throughout the financial services	4	3.00
		PreReq				Recognise the various stakeholders involved with the various components of the financial services industry, and their particular interests.	3	3.00
						Demonstrate an understanding of the need for, and application of, Materiality and Peer Review	3	3.00
						Presumes an ongoing application throughout course - in particular, when the course is split over more than one semester/term, these materials will be addressed in each semester/term		

Quantifying and Assessing Learning Objectives

	2								
		A	1		1	1 Apply the Tests of Professionalism		3	10.00
		B			1	Identify the principles of professionalism and relate them to the actuarial profession		3	2.00
		C				Outline the main features of the IAAust's Code of Conduct		2	2.00
		D			1	1 Discuss the roles of the Senior Actuary		2	2.00
		E			1	Outline the main features of the IAAust's professional standards and the major Guidance Notes		2	2.00
						Identify situations where actuarial expertise may be insufficient, and analyse what consequent actions might then be appropriate.		4	2.00
		PreReq				Presumes an ongoing application throughout course - in particular, when the course is split over more than one semester/term, these materials will be addressed in each semester/term			
	2					The General Economic and Commercial Environment			
						1 Relate the Main Features Within the General Environment in Australia to Medium and Long Term Commercial Decisions		3	5.00
		A			1	Interpret how the present economic conditions and the social, demographic and economic trends within a community can affect the medium to long term commercial decisions		3	1.25
		B			1	Relate the implications of current Government policy to these decisions		3	1.25
		C	1			Relate the consumerism movement and its consequences to decisions made in financial services		3	1.25
		D	1			Discuss the impact of technology (eg e-commerce) on financial services (eg privacy etc)		2	1.25
						Examine the Need for, and Role of, Regulation of the Financial Services		4	10.00
		A			1	Identify, and discuss the roles of, regulators of a financial system		2	2.00
		B			1	Evaluate the role(s) and objectives of regulators in the Australian financial systems		4	2.00
		C			1	Relate the main features of the major pieces of legislation to the regulatory framework as they affect the work of the actuary		3	2.00
		D			1	Outline, in broad terms, the taxation treatment of financial services and insurance industry participants.		2	2.00
		E	1			Explain the statutory roles of actuaries, other independent professionals, and their interactions.		2	2.00

Quantifying and Assessing Learning Objectives

	5				1	1 Analyse the Main Features and Risks of a Range of Both Investment and Non-investment Risk Based Products, their Distribution, and the Implications for the Providers of these Products	4	10.00
		A			1	Discuss the needs of consumers that are met by financial products and the major considerations that providers need to assess to meet these objectives	2	1.43
		B	1			Distinguish the main forms of distribution for financial services products and interpret the impact of varying distribution channels on the development and management of products	3	1.43
		C	1			Identify the main features and objectives of consumer protection requirements and the relate this to the responsibilities of both consumer and providers	3	1.43
		D			1	Identify the main features of commonly available financial services and risk based products and differentiate the advantages and disadvantages of each contract to the provider and consumer	3	1.43
		E	1			Discuss life cycles of products, and evaluate the impact on both consumers and providers	3	1.43
		F			1	Discuss the financial, business, and political risks associated with offering the products discussed above in relation to both provider and consumer	3	1.43
		G			1	Identify the range of marketing strategies available to financial services institutions, and discuss the effect that alternative marketing strategies may have on the quality and quantity of business generated	2	1.43
		PreReq				An understanding of the principal terms used in financial services Principal terms used in [life insurance, general insurance and superannuation] financial services The main features of the insurance markets, the common life and general insurance contracts, and the risk based financial products offered by other financial institutions and the advantages and disadvantages of each contract to the provider and consumer		

Quantifying and Assessing Learning Objectives

3					Specify the Problem		
	6				1 Apply a Risk Assessment Framework to Identify and Assess the Risks in a Range of Commercial Situations.	3	15.00
		A	1		Describe risk analysis frameworks, including a discussion of operational risk, and identify the stakeholders involved and the risks they face in the financial services.	2	1.50
		B			1 Relate the concept of financial risk evaluation to a range of financial products, with particular reference to assets in isolation (eg derivatives), liabilities in isolation (eg reinsurance) and asset-liability management, from the point of view of the provider and the consumer.	3	1.50
		C			1 Demonstrate an understanding of the considerations that need to be taken into account in the decision of accepting, transferring, or rejecting risk	3	1.50
		D		1	Discuss the factors affecting the development of on-going capital requirements for the insurer, financial institutions or employer offering risk-based and other financial products	2	1.50
		E		1	Discuss the importance of quality data in the assessment of risks and identify checks that could be used	2	1.50
		F			1 Relate the roles of marketing, management (including pricing) and valuation to risk and discuss their on the risks accepted	3	1.50
		G			1 Explain the major risks faced by the long term insurer, identify factors that are likely to affect their future experience, and they may be handled	2	1.50
		H			1 Explain the effect of variations in the major areas of risk and uncertainty faced by general insurers and how they may be handled	2	1.50
		I			1 Explain the major risks faced by employers and members of defined benefit and defined contribution superannuation plans and how they may be handled	2	1.50
		J			1 Explain the impact of guarantees and options on the risks faced by providers and how they may be handled	2	1.50

Quantifying and Assessing Learning Objectives

	7				1	Discuss and Apply the Process of Product Design.	3	15.00
		A			1	Outline and relate the factors to consider in determining a suitable design for a range of financial products (including but not limited to a new contract for life insurance, general insurance, and the design of superannuation plans) from perspectives of the major stakeholders (provider, consumer etc)	3	2.14
		B	1			Explain the interaction between the different disciplines in a product development process, including pricing, sales & marketing, compliance etc.	2	2.14
		C	1			Outline the protections available to consumers of financial products (including insurance and wealth creation products)	2	2.14
		D			1	Describe, in brief, the purpose and process of risk assessment (underwriting), the impact of adverse selection, and identify its role in financial product design	2	2.14
		E			1	Describe, in brief, the operation of the main types of reinsurance in life insurance, general insurance and superannuation, and apply them financial product design and management	3	2.14
		F	1			Explain Policyholder Reasonable Expectations and how they can be managed	2	2.14
		G	1			Explain particular issues that need to be taken into consideration in the design of group products in contrast to individual products in the financial services.	3	2.14
	4					Developing the Solution		
	8				1	Select an Appropriate Model to Solve Client Problems.	4	10.00
		A			1	Identify the objectives of-building a model for the management of risk based and other financial products, from the perspective of users and other stakeholders.	3	1.25
		B			1	Describe the basic features of models and their limitations in relation to how are they intended to achieve the objectives	2	1.25
		C			1	Identify the parameters required in the models and how to estimate reflecting underlying assumptions.	3	1.25
		D	1			Explain the purpose and role of 'best estimate' assumptions	2	1.25
		E			1	Discuss the interrelationships between the parameters and assumptions within the model and the way in which the model objectives affect the choice of these parameters and assumptions	2	1.25
		F			1	Explain the need for assessing the sensitivity of the results to changes in the major assumptions and demonstrate an understanding of how the results from models are influenced by its assumptions.	3	1.25
		G			1	Discuss the advantages and disadvantages of stochastic and deterministic models for decision making, including the limitations of each approach.	3	1.25
		H			1	Design and explain the choice of models for use in practical situations, including the major financial services applications.	5	1.25

Quantifying and Assessing Learning Objectives

9				1	Apply Appropriate Techniques to the Pricing and Ongoing Management of Financial Services Products	3	15.00
	A			1	Discuss the general objectives of pricing for each stakeholder and the interrelationship of their particular needs and requirements.	3	2.50
	B			1	For each assumption used in the modelling process, specify the information required, explaining its relevance, outlining problems that may arise in obtaining the required information, and how these issues may be addressed in determining the appropriate assumption.	3	2.50
	C			1	Describe and apply processes for setting margins (either implicit or explicit) that may be used in the pricing process for profit and/or other purposes.	3	2.50
	D		1		Describe the role of profit testing and its relationship with the desired return on capital invested	2	2.50
	E	1			Demonstrate an understanding of the impact of the demographic assumptions underlying the pricing process, both in developing products and in their ongoing management, from both at an individual and group level.	3	2.50
	F	1			Apply the pricing process in a variety of practical situations - for example, but not limited to, investment based products, claims behaviour for general insurance products, and the provision of superannuation benefits.	2	2.50
	PreReq				An understanding of what capital is		
10					Demonstrate an Understanding of the Application and Management of Unit Pricing and Other Interest Attribution Processes	3	10.00
	A	1			Apply unit pricing methodologies and comparison of results	3	2.50
	B	1			Examine interest attribution methodologies for non unit linked investment and retirement products	4	2.50
	C	1			Relate links to external organisations, timing, administrative controls required, high risk areas	3	2.50
	D	1			Interpret equity between clients and performance measurement	3	2.50
	PreReq				Understanding of Unit Linked, Investment account etc products		

Quantifying and Assessing Learning Objectives

11				1	Determine Liabilities and Reserves for a Range of Financial Products.	3	25.00
	A		1		Discuss the need for policy reserves and how these needs differ between different products and in different circumstances	2	1.92
	B			1	Compare and contrast the different purposes for which a valuation of liabilities and assets may be needed in different areas of the financial services	4	1.92
	C			1	Describe the different approaches to dealing with uncertainty in reserving	2	1.92
	D			1	Relate data requirements, specification, verification, correction and materiality to the purpose of the valuation being undertaken	3	1.92
	E			1	Explain the need for assessing sensitivities and reasonableness of the valuations, identifying the major drivers of change, both at a point in time and over time, and the how these may be communicated and interpreted to a client	3	1.92
	F		1		Discuss the reserves that may be needed in respect of the guarantees and other options for long term products	2	1.92
	G			1	Discuss and apply the major criteria in the selection of discount factors in the calculation of reserves	3	1.92
	H			1	Discuss and interpret methods for determining life insurance liabilities, and in particular, the Margin on Services method.	3	1.92
	I			1	Select appropriate methods and apply them to provide estimates of outstanding claims reserves and IBNR and discuss the suitability of these techniques for particular circumstances	3	1.92
	J			1	Discuss and interpret the advantages and disadvantages of funding, PAYG and book reserving for superannuation liabilities	3	1.92
	K			1	Describe the range of funding methods available for the valuation of a defined benefit superannuation fund and interpret the criteria against which they may be judged	3	1.92
	L	1			Explain to clients actuarial results in the context of the relevant legal and accounting requirements and terminology	2	1.92
	M	1			Identify and compare reserving issues in other major areas of financial services and in other broader business applications.	2	1.92
	PreReq				Understanding of the main methods of determining general insurance liabilities Understanding of the main methods of computing superannuation liabilities (per Objective J)		

Quantifying and Assessing Learning Objectives

	12		1		Recognise the Implications of Solvency and How to Manage Future Levels of Solvency	4	25.00
		A		1	Discuss the alternative measures of solvency with reference to assets and liabilities	2	4.17
		B	1		Identify and relate the key components of solvency requirements (including admissibility, concentration, resilience and mismatching)	2	4.17
		C		1	Relate the interaction between solvency, best estimates of liabilities, prudential margins and release of profit	3	4.17
		D		1	Describe how to project future levels of solvency in each area and how to respond to these results	3	4.17
		E		1	Demonstrate the ongoing need for solvency and, where appropriate, the nature and role of the estate	3	4.17
		F		1	Discuss the objectives of regulators and professional bodies in setting solvency standards	2	4.17
		Note			'Solvency' is used in a generic sense. (Eg, it included Life Solvency& Life Capital Adequacy and 12(e) implies consideration of ongoing capital management)		
5			1		The Investment Process		
	13		1		Demonstrate an Understanding of the Investment Decision Process and Analyse the Process to Solve Investment Problems	4	15.00
		A		1	Interpret the major influences, economic and other, affecting the investment decision	3	3.75
		B	1		Identify the liability (the 'Liability Asset') and determine the key investment characteristics and risks that drive the need for the investment (for example, life insurance policies, retirement plans, corporate capital structures)	3	3.75
		C		1	Interpret the application and limitations of the main methods used to value the common forms of debt, equity and derivative securities	3	3.75
		D	1		Discuss and interpret the major factors, including the role of liabilities, the attitude to risk, liquidity requirements and any gearing restrictions that should be taken into account in establishing an investment strategy.	3	3.75
		PreReq			Describe features of the main investment alternatives available in the market (together with their historical risk characteristics), including: money market instruments; Government and corporate debt; Australian equities; overseas equities and fixed interest; direct property and property trusts; futures, swaps and options Basic knowledge to valuation methods etc ex Part I Basic knowledge of financial instruments ex part I Outline, in broad terms, the taxation treatment of different forms of investments for an institutional investor		

Quantifying and Assessing Learning Objectives

14		1		Construct and Explain the Investment Portfolio	5	20.00
	A	1		Determine an appropriate asset allocation to suit the liability and the key variables of the portfolio (strategic/tactical, allocation ranges, interpretations of risk and return)	4	4.00
	B	1		Discuss and relate the practical implementation of investment mandates, including the roles of major stakeholders in the process - fund manager, custodians, etc	3	4.00
	C		1	Demonstrate an understanding of the application and limitations of the major theories in the capital markets - including the efficient market hypothesis, the capital asset pricing model and the arbitrage pricing theory	3	4.00
	D	1		Discuss and interpret the practical management of risks inherent in counter party trading in a modern investment environment, especially in derivative positions	3	4.00
	F		1	Analyse the asset-liability matching requirements of insurers and superannuation funds and explain how projection methods with and without stochastic features can be used to determine the appropriate strategic and tactical asset allocation for institutional funds	4	4.00
15		1		Analyse the Ongoing Investment Decision and Explain the Implications of the Results	4	10.00
	A		1	Explain how returns on asset portfolios should be monitored and assessed including the appropriate usage of the different methods of calculating returns, performance attribution to asset classes and security selection, to allow for risk	3	2.00
	B	1		Identify the key items from the investment mandate which need to be monitored, how these items should be monitored in regard to the Liability Asset, and how this information should be interpreted and communicated	3	2.00
	C	1		Discuss and apply criteria by which the success of the investment decision can be assessed over time.	3	2.00
	D		1	Discuss the considerations that should be taken into account in the ongoing valuation of assets and how this should be related to the ongoing valuation of liabilities and need for any additional reserves	2	2.00
	E	1		Identify how the asset-liability monitoring process can be used to benefit the investment decision process	2	2.00

Quantifying and Assessing Learning Objectives

6	16	A	1	1	1	Monitoring the Experience		
					1	Monitor and Assess Actual Experience.	4	15.00
					1	Identify the critical elements of experience (in particular, but not limited to, expense analyses for life insurance and claims analyses for general insurance)	2	3.00
						Identify appropriate measures of experience	2	3.00
						Undertake an experience analysis	3	3.00
	17	A	1	1				
					1	Compare the Measures of Assessment of Value, and Their Limitations, for Financial Services Providers.	4	15.00
						Distinguish the main valuation methods, internal DCF, external market reference, Appraisal/Embedded Values.	4	3.00
						Recognise purposes of valuation, differing considerations for each purpose	4	3.00
						Examine 'Fair Value', its current uses and future outlook.	4	3.00
	18	A	1	1				
					1	Interpret the Sources of Profit and the Factors that Affect the Distribution of this Profit	3	10.00
					1	Demonstrate Analysis of Profit and its place in the APC	3	2.50
1					Generalise the main sources of profit of insurers and superannuation funds and how this analysis can be used to check the accuracy and completeness of valuation data	3	2.50	
	1	Relate appropriate ways of allocating profit for an insurer and achieving equity between different groups of policyholders and shareholders	3	2.50				
	1	Relate the methods available to handle surpluses or deficits within superannuation plans and achieving equity between groups of members.	3	2.50				

Appendix B: Numeric Assessment of Proposed Syllabus - Actuarial Practice & Control Learning Level

INSTITUTE of ACTUARIES of AUSTRALIA **SUMMARY**
Part II: Actuarial Practice & Control Course
Syllabus - Numerical Assessment - From Review

Unit	Aim	Object	Weight %	Learning Taxonomy					6Total	Ave Learn Level		
				1	2	3	4	5				
Overview of Approach and Professionalism												
1			10%									
				Aim + Objective	0	9	36	5	0	0	50	
	1	5	15	6%	0%	18%	72%	10%	0%	0%	2.92	
	2	5	10	4%	Objective Only	0	9	11	5	0	0	25
						0%	36%	44%	20%	0%	0%	2.84
				Aim Only	0	0	25	0	0	0	25	
					0%	0%	100%	0%	0%	0%	3.00	
The General Economic and Commercial Environment												
2			10%									
				Aim + Objective	0	10.1	17.9	22	0	0	50	
	3	4	5	2%	0%	20%	36%	44%	0%	0%	3.24	
	4	5	10	4%	Objective Only	0	10.1	12.9	2	0	0	25
	5	7	10	4%		0%	40%	52%	8%	0%	0%	2.68
				Aim Only	0	0	5	20	0	0	25	
					0%	0%	20%	80%	0%	0%	3.80	
Specify the Problem												
3			12%									
				Aim + Objective	0	19.1	40.9	0	0	0	60	
	6	10	15	6%	0%	32%	68%	0%	0%	0%	2.68	
	7	7	15	6%	Objective Only	0	19.1	10.9	0	0	0	30
						0%	64%	36%	0%	0%	0%	2.36
				Aim Only	0	0	30	0	0	0	30	
					0%	0%	100%	0%	0%	0%	3.00	
Developing the Solution												
4			34%									
				Aim + Objective	0	30.9	98.5	39.4	1.25	0	170	
	8	8	10	4%	0%	18%	58%	23%	1%	0%	3.07	
	9	6	15	6%	Objective Only	0	30.9	48.5	4.42	1.25	0	85
	10	4	10	4%		0%	36%	57%	5%	1%	0%	2.72
	11	13	25	10%	Aim Only	0	0	50	35	0	0	85
	12	6	25	10%		0%	0%	59%	41%	0%	0%	3.41

Quantifying and Assessing Learning Objectives

The Investment Process

5				18%									
					Aim + Objective	0	4	33	33	20	0	90	
13	4	15	6%			0%	4%	37%	37%	22%	0%	3.77	
14	5	20.00	8%		Objective Only	0	4	33	8	0	0	45	
15	5	10	4%			0%	9%	73%	18%	0%	0%	3.09	
					Aim Only	0	0	0	25	20	0	45	
						0%	0%	0%	56%	44%	0%	4.44	

Monitoring the Experience

6				16%									
					Aim + Objective	0	6	29	45	0	0	80	
16	5	15	6%			0%	8%	36%	56%	0%	0%	3.49	
17	5	15	6%		Objective Only	0	6	19	15	0	0	40	
18	4	10	4%			0%	15%	48%	38%	0%	0%	3.23	
					Aim Only	0	0	10	30	0	0	40	
						0%	0%	25%	75%	0%	0%	3.75	

TOTAL	18	108	250	100%	Aim + Objective	0	79	255	144	21.3	0	500	
						0%	16%	51%	29%	4%	0%	3.22	
					Objective Only	0	79	135	34.4	1.25	0	250	
						0%	32%	54%	14%	1%	0%	2.83	
					Aim Only	0	0	120	110	20	0	250	
						0%	0%	48%	44%	8%	0%	3.60	

Appendix C: Incumbent Syllabus - 2000 IAAust Actuarial Control Cycle Syllabus

Detailed Syllabus:

Part A

Aim 1: Discuss the actuarial control cycle and explain the purpose of each component within it

- a) Describe the reason for each element within the cycle
- b) Explain the inter-relationship between the various elements
- c) Discuss how the cycle could be used in respect of a range of financial products
- d) Identify and apply the principles of good communication, in particular report writing and presentations

Part B

Aim 2: Explain the importance of the main features within the general environment in Australia as they affect medium-to-long term commercial decisions

- a) Explain how the present economic conditions and the social, demographic and economic trends within a community affect medium-to-long term commercial decisions
- b) Discuss the implications of current Government policy on these decisions
- c) Describe the roles of regulators of a financial system with particular reference to APRA and ASIC in the supervision of the Australian financial system
- d) Outline, in broad terms, the taxation treatment of life insurance companies, general insurance companies and superannuation funds
- e) Describe the main features of the major pieces of legislation as they affect the work of the actuary in life insurance, general insurance, superannuation and other financial products with illustrations from a number of countries

Aim 3: Analyse the general features of financial products from the perspective of both consumers and providers, with particular reference to identifying the risks

- a) Discuss the needs of consumers that are met by financial products and the major considerations that providers need to assess to meet these objectives
- b) Define the principal terms used in life insurance, general insurance and superannuation
- c) Describe the main features of the insurance markets, the common life and general insurance contracts, and the risk-based financial products offered by other financial institutions and the advantages and disadvantages of each contract to the provider and consumer
- d) Describe the major forms of superannuation available and their respective advantages and disadvantages
- e) Discuss the financial, business and political risks, for both the provider and consumer, associated with offering the above mentioned products
- f) Discuss the effect that alternative marketing strategies may have on the quality and quantity of business generated

Part C

Aim 4: Assess the risks relevant to a particular commercial situation and suggest how they can be handled

- a) Discuss the concept of risk evaluation in general, but with particular application to assets in isolation (eg derivatives), liabilities in isolation (eg reinsurance) and asset-liability management
- b) Discuss the factors affecting the development and ongoing capital requirements for the insurer, financial institution or employer offering risk-based and other financial products
- c) Discuss the considerations that need to be taken into account in the decision of accepting, transferring or rejecting risk
- d) Explain how marketing, management and valuation considerations may impact on the risks accepted
- e) Discuss the importance of quality data in the assessment of risks and identify checks that could be used
- f) Describe the major risks faced by the long-term insurer from possible variations in mortality and morbidity, investment performance, taxation, expenses, inflation, the mix of and volume of new business and identify the factors that are likely to affect the future experience of these items and how these can be handled
- g) Describe the effect of variations in the major areas of risk and uncertainty faced by general insurers and how these can be handled
- h) Describe the major risks faced by employers and members of defined benefit and defined contribution superannuation plans and how these can be handled
- i) Describe the impact of certain guarantees and options in life insurance, general insurance and superannuation on the risks faced by the provider and how these can be handled
- j) Illustrate the principles through the use of a non-traditional example

Aim 5: Discuss alternative designs of contracts which may be suitable to provide protection to consumers in respect of a range of financial needs

- a) Outline the factors to consider in determining a suitable design in terms of benefits and charges for a new contract in life insurance or general insurance
- b) Discuss the factors that need to be considered in the design of a superannuation plan in Australia, including insurance requirements
- c) Discuss the major factors that need to be considered in the design of a retail investment or loan product, with or without capital guarantees
- d) Describe, in brief, the purpose and process of risk assessment (underwriting), and the impact of adverse selection
- e) Describe, in brief, the operation of the main types of reinsurance in life insurance, general insurance and superannuation

Part D

Aim 6: Explain the advantages of using models, describe the main features of the models required for decision making purposes and how they should be used to establish and test the best solution for the client's problem

- a) Discuss the objectives of and requirements for building a model using current technology for the management of risk-based and other financial products
- b) Describe the requirements of the model from the perspective of the ultimate users
- c) Describe the basic features of a model required to project the experience of a portfolio of financial contracts
- d) Discuss the advantages and disadvantages of stochastic and deterministic models
- e) Identify the assumptions required in the models to assist in the actuarial management of the product
- f) Discuss how to estimate the model's parameters
- g) Discuss the interrelationships between the parameters within the model and the way in which the choice of parameters could be affected by the risk management strategy chosen
- h) Demonstrate the use of these models in terms of:
 - emerging cash flows and present values, for the purposes of product pricing or contribution levels and profit testing,
 - benefit levels, and
 - the return on capital, allowing for underwriting and reinsurance considerations
- i) Explain the sensitivity of the results to changes in the major assumptions

Aim 7: Discuss the assumptions that could be used in the pricing and ongoing management of financial products

- a) Discuss the general objectives of pricing, with particular reference to statutory certification, pricing strategy and the funding of non-contractual benefits
- b) For each assumption used, specify the information required, explain the relevance of the item and outline any problems that may arise in obtaining the required information to determine the appropriate assumption
- c) Describe the margins (either implicit or explicit) that may be used in the modelling and pricing process for profit and other purposes
- d) Describe the role of profit testing and its relationship with the desired return on the capital invested
- e) Describe the principles of pricing in respect of investment based products including investment accumulation and market-linked funds, including the cost of any capital guarantees
- f) Assess the costs of potential claims and expenses under a general insurance contract with reference to premiums, rating requirements and the impact of possible changes in the mix and volume of business
- g) Explain the economic and demographic factors which can affect the cost of providing superannuation benefits and how the assumptions may be determined
- h) Illustrate the principles through the use of a non-traditional example

Aim 8: Describe how liabilities and reserves, where necessary, could be calculated and how these could vary using different methods and assumptions

- a) Discuss the need for policy reserves and how these needs differ between different products and in different circumstances
- b) Discuss the different purposes for which a valuation of liabilities and assets may be needed with respect to life insurance, general insurance or superannuation products
- c) Discuss the extent to which the reserves should reflect the uncertainties of the future outcomes
- d) Explain why the assumptions used for reserving may be different from those used in pricing
- e) Discuss the data requirements for valuation in life insurance, general insurance and superannuation and the verification procedures required in each case
- f) Discuss the sensitivity of the results of asset and liability valuations for life insurance, general insurance and superannuation, and hence, the assumptions that are most important
- g) Discuss the differences between best estimates and the level of reserves that may be recommended for valuation purposes
- h) Discuss the Margin on Services method for determining life insurance liabilities and the need for additional assets to satisfy the solvency and capital adequacy standards.
- i) In respect of unit linked business, discuss the need for reserves in excess of the liability
- j) Discuss the reserves that may be needed in respect of guarantees and other options for long term products
- k) Describe several techniques to produce estimates of outstanding claims reserves and IBNR and discuss the suitability of these techniques for particular circumstances
- l) Discuss the use of a discount factor in the calculation of reserves for general insurance business
- m) Discuss the appropriateness of margins in excess of the central estimate of outstanding claims liabilities
- n) Discuss the advantages and disadvantages of funding, PAYG and book reserving for superannuation liabilities
- o) Describe the range of funding methods available for the valuation of a defined benefit superannuation fund and the criteria against which they may be judged
- p) Illustrate the principles through the use of a non-traditional example

Aim 9: Describe the different investment alternatives that are available in the capital markets

- a) Describe the features of the following financial instruments, together with their historical risk characteristics:
 - money market instruments
 - Government and corporate debt
 - Australian equities
 - overseas equities and fixed interest
 - direct property and property trusts
 - futures, swaps and options
- b) Describe the major economic influences affecting the behaviour of the financial markets

- c) Outline, in broad terms, the taxation treatment of different forms of investments and the importance of tax considerations for an institutional investor
- d) Discuss the main methods used to value the common forms of debt, equity and derivative securities
- e) Describe and discuss the major theories in the capital markets including efficient market hypothesis, the capital asset pricing model and the arbitrage pricing theory

Aim 10: Discuss the selection of assets in view of the liabilities

- a) Describe the portfolio management process for institutional investors (including life insurance, general insurance, health insurance and superannuation funds) including planning the investment strategy, implementing the strategy and monitoring the performance of the strategy
- b) Discuss the factors, including the role of liabilities, the attitude to risk, liquidity requirements and any gearing restrictions to be taken into account in establishing an investment strategy
- c) Analyse the asset-liability matching requirements of insurers and superannuation funds and explain how projection models with and without stochastic features can be used to determine the appropriate asset-liability management strategy
- d) Outline and discuss methods of implementing the investment strategy including manager selection and the role and importance of strategic and tactical asset allocation for institutional funds
- e) Discuss the considerations that should be taken into account in the valuation of assets and how this should be related to the valuation of liabilities and any additional reserves
- f) Describe and discuss how returns on asset portfolios should be monitored and assessed including different methods of calculating returns, performance attribution to asset class and security selection, and allowing for risk

Aim 11: Discuss alternative definitions of solvency and how to assess future levels of solvency

- a) Discuss the reasons for measuring solvency
- b) Discuss the alternative measures of solvency for life insurance business, general insurance business and a superannuation fund including the valuation of assets
- c) Discuss how to project future levels of solvency in each area and how to respond to these results
- d) Describe the differences between a best-estimate valuation of life policy liabilities and a valuation for solvency/capital adequacy purposes
- e) Discuss the ongoing need for capital and, where appropriate, the nature and role of the estate
- f) Discuss the objectives of APRA and the IAA in setting minimum solvency standards
- g) Discuss the effects of any accounting standards on the measures of solvency
- h) Illustrate the principles through the use of a non-traditional example

Part E

Aim 12: Describe how the actual experience should be monitored and assessed

- a) Discuss the reasons for monitoring experience and how these results link into the control cycle
- b) Identify the data required to monitor the experience of a life insurance company, a general insurance company and a superannuation fund
- c) Discuss the concept of expense analysis and how it can be carried out in a range of circumstances
- d) Analyse the experience of a life insurer with reference to claims experience and investment performance
- e) Analyse the experience of a general insurer with reference to claim and exposure analysis, portfolio analysis and movement analysis
- f) Analyse the experience of a defined benefit superannuation fund for valuation and other purposes with reference to investment returns, salary movements and decrements
- g) Discuss how the analysis of this experience may cause changes in the previous assumptions, the model used, the risks accepted or other aspects of the business

Aim 13: Identify the sources of any profit and discuss the factors that affect the distribution of this profit

- a) Explain the link between profit and other items in the actuarial control cycle
- b) Describe the main sources of profit for an insurer and superannuation fund, and explain how this analysis can be used to check the accuracy and completeness of valuation data
- c) Describe appropriate ways of allocating profit for an insurer and achieving equity between different groups of policyholders and shareholders
- d) Discuss the methods available to handle surpluses and deficits within a superannuation plan, including the issue of equity

Part F

Aim 14: Apply the tests of professionalism

- a) Outline the main features of the IAA's code of conduct
- b) Discuss the main features of the IAA's professional standards and the major Guidance Notes
- c) Discuss situations where actuarial expertise may be insufficient
- d) Discuss the roles of the Appointed Actuary and the Senior Actuary

Part G

Aim 15: Explain how the actuarial control cycle approach and actuarial techniques can be used to tackle many commercial problems

- a) Discuss the application of the total cycle using both traditional and non-traditional products

Appendix D: Summary of Review of Part III – Life Insurance

**INSTITUTE of ACTUARIES of AUSTRALIA
LIFE INSURANCE EXAMINATION - PART III
Syllabus - ex 2001 Examinations Handbook**

**SUMMARY
28-Apr-01**

Unit	Aims	Objectives		Learning Taxonomy					6Subtotal	Average Difficulty		
				1	2	3	4	5				
1	1	3	Aim + Objective	0	11	2	0	0	0	13		
				0%	85%	15%	0%	0%	0%		2.15	
	3	4	Objective Only	0	9	1	0	0	0	10		
				0%	90%	10%	0%	0%	0%		2.10	
			Aim Only	0	2	1	0	0	0	3		
				0%	67%	33%	0%	0%	0%		2.33	
2	4	4	Aim + Objective	0	2	2	2	1	1	8		
				0%	25%	25%	25%	13%	13%		3.63	
	5	2	Objective Only	0	2	2	2	0	0	6		
				0%	33%	33%	33%	0%	0%		3.00	
			Aim Only	0	0	0	0	1	1	2		
				0%	0%	0%	0%	50%	50%		5.50	
3	6	4	Aim + Objective	0	2	0.5	0.5	1	1	5		
				0%	40%	10%	10%	20%	20%		3.70	
				Objective Only	0	2	0	0	1	1	4	
					0%	50%	0%	0%	25%	25%		3.75
			Aim Only	0	0	0.5	0.5	0	0	1		
				0%	0%	50%	50%	0%	0%		3.50	
4	7	3	Aim + Objective	0	1	0	3.5	2	0.5	7		
				0%	14%	0%	50%	29%	7%		4.14	
	8	2	Objective Only	0	1	0	1.5	2	0.5	5		
				0%	20%	0%	30%	40%	10%		4.20	
			Aim Only	0	0	0	2	0	0	2		
				0%	0%	0%	100%	0%	0%		4.00	
5	9	4	Aim + Objective	0.5	7	3.5	3	7	4	25		
				2%	28%	14%	12%	28%	16%		3.84	
	11	5	Objective Only	0.5	7	3	2.5	4	3	20		
				3%	35%	15%	13%	20%	15%		3.58	
	13	4	Aim Only	0	0	0.5	0.5	3	1	5		
			0%	0%	10%	10%	60%	20%		4.90		
6	14	2	Aim + Objective	0	4	2.5	0.5	3	2	12		
				0%	33%	21%	4%	25%	17%		3.71	
	16	4	Objective Only	0	4	2.5	0.5	0	2	9		
				0%	44%	28%	6%	0%	22%		3.28	
			Aim Only	0	0	0	0	3	0	3		
				0%	0%	0%	0%	100%	0%		5.00	

Quantifying and Assessing Learning Objectives

7	17	3	Aim + Objective	0	2	0	0.5	0.5	1	4	
				0%	50%	0%	13%	13%	25%		3.63
			Objective Only	0	2	0	0	0	1	3	
				0%	67%	0%	0%	0%	33%		3.33
			Aim Only	0	0	0	0.5	0.5	0	1	
				0%	0%	0%	50%	50%	0%		4.50
TOTAL	17	57	Aim + Objective	0.5	29	10.5	10	14.5	9.5	74	
				1%	39%	14%	14%	20%	13%		3.51
			Objective Only	0.5	27	8.5	6.5	7	7.5	57	
				1%	47%	15%	11%	12%	13%		3.26
			Aim Only	0	2	2	3.5	7.5	2	17	
				0%	12%	12%	21%	44%	12%		4.32