EDUCATING ACTUARIES

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Abstract

How should we educate actuaries? This paper places current and potential future responses to this question within the framework of the actuarial control cycle. It focuses, in particular, on the challenges to specifying, developing and assessing higher-level learning (i.e. skills and attitudes). In doing so it identifies a number of unanswered key questions and avenues for future research.

Key words: education, learning, assessment, competencies, capabilities, control cycle

1. Specify the problem

What is education?

Before considering the specific actuarial context it is necessary to clarify what is meant by education. In this paper, education is defined as the process by which an individual achieves and is credited with having achieved specified appropriate learning. How then might we describe the possible components of learning? There are many such descriptions, but perhaps the most referenced is Bloom's taxonomy (1956), or derivations thereof (Pohl 2000), which might be summarised as:

- knowledge
- understanding (comprehension) – e.g. schema development
- skills (cognitive and psychomotor) – e.g. analysis, evaluation, synthesis, application
- Attitudes (affective) – e.g. accepting professional standards, dealing with conflict.

It has been argued in the past that the actuarial education system has made an inappropriately high level of investment into the earlier items in this list. "It may be questioned whether there is in fact any particular merit in continuously striving to be up-to-date. A newly qualified actuary will be out of date within a short time of completing the examinations… The essence of the examinations is to test his grasp of principles and practicability, not his knowledge of up-to-the-minute detail. The assiduous annual pursuit of up-dating the course of reading therefore achieves an entirely spurious impression" (Truckle 1982). "The focus tends to be on what actuaries need to know at the expense of what actuaries may need to do when they practise in the real world" (Shepherd 2010).

Although, ideally, effort should be made on "improving the curriculum design… by using up-to-date, relevant syllabuses and study materials" (Hardy 1990) this paper takes Truckle's view and argues that it is more important to focus upon the latter components of the above list. In doing so, it supports other voices (referenced below) that are calling for a greater investment into educational developments that support such higher-level learning.

Start with the end in mind

The first stage of the control cycle is that of *Specifying the Problem*. So what are our objectives in the current context? What success criteria should we use when evaluating an approach to educating actuaries?

The assumption taken by this paper is that our objective is to optimise the *supply* of actuaries though appropriate educational provision. The optimisation is in terms of both the *number* and *quality* of newly-qualified actuaries.

With regard to the optimisation of supply in terms of the *number* of actuaries, we need to recognise that the actuarial profession is competing (against other professions and occupations) for talented students. To attract such individuals, a profession must be recognised as offering an education useful to many future roles, not just current 'actuarial' roles. So the two dimensions of the above objective (number and quality) are linked.

To help ensure the objective is well-defined with regard to *quality* we might consider what characteristics the 'ideal actuary of the future' should exhibit and then work backwards. Consider the following suggestion:

An actuary should "be broadly based and well balanced, possessing not academic conceit of the narrow specialist, but the intellectual poise which is the hallmark of sound education. In addition, (s)he should combine scientific interest with a practical outlook, enthusiasm with a sense of proportion, confidence in his/her knowledge with due recognition of its limitations, leading to a willingness to perfect his/her practical and theoretical grasp of any particular aspect of his/her work before incurring statutory or professional responsibility." He/she should also have "a desire to contribute by his/her further studies to the vitality of the profession."

Clearly this is an incomplete specification as it lacks any indication of the particular knowledge that an actuary should possess. However, what it does do is challenge us to think about what, in addition to specific knowledge, should be the key distinguishing characteristics of a qualified actuary. Having identified these characteristics, we then can move on to consider what educational provisions are appropriate.

(It is interesting to note that the quotations forming the suggested specification, above, are not recent. They are from a report in 1946 by the Lever Committee that had been established to review the Institute's educational system in the UK.)

So *how* might we seek to define these characteristics that *should*, in the future be part of how we define an actuary?

Who is the customer?

If we wish to optimise the *supply* of actuaries though appropriate educational provision we need to have an expectation as to what future *demands* there will be for and upon actuaries.

A strategic review ('gap analysis') by the UK Profession (2005) provides some possible answers to this question: "There is continued demand for actuaries from current employers with no reduction in demand anticipated in the short to medium term, but potentially in the longer term.

Strong consistent views from employers are that actuaries need:

- much more business understanding
- far stronger communication skills
- better ability to work in multi-disciplinary teams."

"Customers… criticisms revolve around:

- insufficient real world understanding
- lack of business judgement
- patchy and sometimes inadequate communication skills, and
- a tendency to act as judge and jury."

However, we should bear in mind the potential limitations of any such review. For example, the source data in this instance was obtained from current employers of actuaries, pension trustees and insurance non-executive directors. What weight should we be giving to the voices of other possible future 'customers', for example the Chief Risk Officers of non-financial companies?

Such perspectives have not been limited to the UK market for actuaries. For example, in the USA, "actuaries possess no strong competitive advantage in non-traditional financial institutions, because they have no particular training or experience in a business context. Presently, actuaries all too often compete solely on the basis of mathematical skills heavily skewed toward the modelling of insurance and employee benefit problems." (Ingraham, 2000)

What learning is appropriate?

Many suggestions have been made as to the capabilities we might desire an actuary to possess. One example is in Australia where the Institute commissioned a set of capability statements (Gribble 2003). Another example of where such capability objectives are beginning to be implemented can be found in the *10 principles for SOA education* (2010). One of these principles refers to a competency framework which includes:

- communication
- professional values
- external forces & industry knowledge
- leadership
- relationship management & interpersonal collaboration
- technical and analytical problem-solving skills
- strategic insight & integration
- results-oriented solutions.

A more specific statement is given for each competency. For example, *communication* is defined as "demonstrating the listening, writing and speaking skills required to effectively address diverse technical and non-technical audiences in both formal and informal settings".

A similar list of skills (the *key dimensions*) appears in the current specification of the work-based skills requirements of the UK Profession.

A common challenge to the specification of any objective is to ask whether it is SMART (specific, measurable, attainable, relevant and time-bounded). Whether an objective is *attainable* within the timescale chosen is likely to be constrained by practicalities specific to the geographic region within which the education system is based and so this is not considered by this paper.

However, constructivists and common sense tells us that it is important that students (and indeed all those within the educational system) understand the *specifics* of the capabilities that are intended to be developed and that they are *relevant*. Otherwise learning will be ineffective (Hardy et. al. 1990).

Taking the example of communication, above, we can see immediately the challenge of defining such capabilities in specific enough terms so as to be fit-for-purpose as learning objectives. What makes a communication "effective"? How "diverse" is the range of audiences? What is meant by "formal and informal settings"? As actuaries we are not necessarily motivated to answer such non-technical questions but it is essential that we do so, otherwise we will fail to complete successfully the first stage of the control cycle.

Before moving on to the second stage of the cycle it is important to recognise that such capabilities cannot be fully developed solely by an educational system that is separate from the working environment. However, growing pressures within the working environment mean that it cannot be assumed that all employers will adequately support such development. A 'minimum level of capability' is required for fellowship and the education system has an important part to play in that being achieved. Initial consideration as to how such 'pre-capabilities' might be defined and developed has already been made (Shepherd 2010) but this remains an important avenue for future research.

2. Develop the solution

Components of a solution

Any solution to optimising the supply of actuaries, both in terms of number and quality, will support two key activities:

- learning - including 'assessment *for* learning', i.e. formative assessment
- 'assessment *of* learning', i.e. summative assessment, being an evaluative judgment of an individual's performance against pre-determined criteria (Brown 1999).

How do we support effective learning?

Various theories have been developed regarding *how* we all learn - behaviourist, cognitive, constructivist etc. - and how we each learn *differently* - learning styles and multiple intelligences (Pritchard 2009).

Constructivist theory (Wray & Lewis 1997) indicates that:

- Learning is a situated process – meaningful contexts for learning are important.

  One of the challenges for an individual commencing their actuarial education is that of forming a schema for what it means to be an actuary. This has led to the conclusion that "a fundamental property of any actuarial curriculum should be a front-end subject that encourages learners to develop a schema for 'actuary'" (Shepherd 2010).

  The introduction of The Actuarial Control Cycle into the actuarial exam syllabus of many regions has improved matters considerably in this, and many other respects. However, this helpful schema has largely been placed in the middle of a typical student's learning path, not at the 'front-end'.

- Learning is a social process – discussion is an important part of learning.
- Learning is a meta-cognitive process – learners should be aware of their own learning processes.

Facilitating the acquisition of the types of capabilities discussed earlier will be next to impossible by means of 'traditional' distance learning. At the same time, it is unlikely that a majority of students will be able to have face-to-face interactions with both peers and actuarial educators. Practical constraints are particularly acute when cohorts of students are fragmented by specialist tracks later in their studies. Developing alternative 'rich' methods of interaction would therefore appear to be an important task if we are to meet our objective.

Making one move in this direction is the SOA's Fundamentals of Actuarial Practice Course (FAP). Students on this course are actively encouraged to interact by means of an online forum. The aim is that they provide mutual support and learn to work collaboratively on assignments.

Multiple intelligence theory (Gardner 1993) and the theory of cognitive/learning styles (e.g. Honey & Mumford 1986, Kolb 1984) indicate that individuals differ in the manner in which they best acquire and demonstrate knowledge and skills.

Some recent research has indicated possible characterisations of actuaries and other business professionals using particular learning-style inventories (Knapp 2003, Shepherd 2004). However, the key point is not so much 'what characterisations might we give students?' but an acknowledgment that different individuals will learn best in differing ways. It isn't the case that 'one size' of learning support will fit all!

Skilled educators will aim to make learning accessible to all members of a cohort despite individuals having differing learning-style preferences. They will present each opportunity for learning in different ways, be flexible and respond dynamically to student feedback. Replicating this experience in a non face-to-face learning environment presents a number of problems. How is information on a student's learning-style preference to be obtained? How can the learning experience be tailored to that preference? Such questions remain largely unanswered.

Responding dynamically to feedback is, however, already a possibility. Students of the UK Institute's exams can benefit from online formative assessment tools. These give feedback to the student as to the weaker areas of their understanding and subsequent assessment is directed automatically onto these development areas. Expansion of the range of such tools for use during the pre-assessment learning phase will be important if we are to meet our objective.

If we focus on the higher levels of Boom's taxonomy, learning might be described as a process by which behaviour is changed or shaped (Pritchard 2009). How then might we facilitate the development of behaviours / competencies that we desire from / in an actuary?

The SOA's FAP course includes some elements that clearly look to develop certain behaviours. In some modules of the course students are first exposed to a series of concepts and are subsequently encouraged to work through a practical problem. Sometimes additional information is provided after an initial solution has been developed by a student. They are then asked to consider their initial solution in the light of the new information and how that solution might be modified. Such exercises look to develop awareness of external forces and strategy insight (both in the SOA's competency framework, referenced above).

This is one example of a much broader range of techniques aimed at *Problem Based Learning* (Boud 1985, in Shepherd 2010). Such techniques seek to help an individual develop their own capabilities not by 'being taught' but through personal experience and reflection.

Problem based learning (PBL):

- is situated – using problems that would realistically be expected to be met by practicing actuaries
- encourages meta-cognitive processes – it makes the process and its objectives explicit to the student
- focuses not just on knowledge acquisition but also, crucially, on the development of capabilities, e.g. interpersonal skills, research skills etc.

There are perhaps three key challenges to the implementation of PBL. Firstly, stakeholders need to identify clearly the capabilities that are desired to be developed. (Of course, this might also be seen as an advantage in that it imposes discipline onto the specification of objectives!) Secondly a significant investment needs to be made to develop the necessary learning resources. Finally, there are the challenges of assessing such higher-level learning – considered in the next section of this paper.

How do we assess learning?

In terms of formative assessment (assessment *for* learning), use is already being made of a variety of techniques including:

- external assessment, e.g. by an at-a-distance marking service
- self-assessment, e.g. using an online testing tool
- peer-review, e.g. between students within a learning cohort
- expert assessment, e.g. by tutors observing a learning-group's behaviour.

However, adoption of the latter two techniques has largely been restricted to students attending face-to-face tutorials – either at a university or as provided by a tuition service.

Summative assessment continues to be performed largely using 'traditional' written examinations, with a few notable exceptions (see below).

Whether formative or summative, students must judge that an assessment is clearly being made against the *full* range of learning objectives that were pre-specified. This is critical because otherwise many students, and some tuition providers, will be tempted simply to satisfice. Although regrettable, this is unlikely to change in the foreseeable future.

Concepts such as content validity and constructive alignment include consideration of the degree to which an assessment corresponds in content and in level to what has been specified in the learning objectives. It is a crucial element of students' perceptions of assessment fairness (Hardy et. al. 1990).

Of specific interest in the context of this paper is the assessment of higher-level learning (e.g. attitudes and certain skills) where it becomes impossible to achieve a high degree of content validity using traditional exams. For example, "it would be irresponsible for a working actuary to make an evaluation of a life office merger after only 10 minutes consideration of the problem, with no access to additional information, with no practical experience of this area of work, and whilst in a state of acute anxiety. Yet these questions are included in exams on the grounds that they are 'realistic'" (Hardy et. al. 1990).

So how might we assess skills such as communication, collaboration and problem-solving? Shepherd (2010) highlights that there are only a few current working examples:

- In the UK, the CA2 2-day 'practical exam' assesses a candidate's capability to document and communicate appropriately the results of an actuarial model.
- Also in the UK, the CA3 2-day 'practical exam' assesses a candidate's ability to communicate actuarial concepts clearly through production and delivery of an effective presentation.
- In the USA the online Fundamentals of Actuarial Practice (FAP) course includes both formative and summative assessment of a candidate's ability to comprehend a large volume of information, modify supplied models so as to be fit-for-purpose, analyse the output and communicate the results by the writing of a report.
- In Australia the 4-day Commercial Actuarial Practice (CAP) course includes an 8-hour summative assessment of similar capabilities to the FAP assessment (above), through analysis of a substantial case-study.

A significant challenge for such ground-breaking work is the achievement of content validity through the development of appropriate assessment criteria. In the case of the FAP course, minimum requirements to pass an example past assessment include:

- demonstration of an awareness of the potential impact of at least one general aspect of professionalism (e.g. regulations or guidance)
- appropriate comments on the quality of the data and model assumptions
- identification of an appropriate range of relevant external forces
- quantification of relevant risks as ranges
- provision of a qualified recommendation under each scenario
- recommendation as to the need for ongoing monitoring.

Such criteria aim to identify whether the candidate has the desired capabilities, through observation of their performance and/or the outputs of that performance, when addressing a realistic and situated problem.

Other key challenges to the expansion of the application of such techniques are the acceptability of such forms of assessment to key stakeholders (e.g. existing membership of the profession) and the significant initial and ongoing investment required.

Feedback into the problem specification

As we work though producing 'the solution' we may discover that we cannot deliver to every objective to which we aspired and/or additional problems may be identified. Such experience informs our understanding of the problem. To assist subsequent generations of actuarial educators we should ensure we maintain a clear 'audit trail' – updating our specification of the problem as we move forward.

3. Monitor the experience

Before proceeding with implementation of 'the solution' we should establish appropriate key performance indicators (KPIs) and key risk indicators (KRI). These will:

- enable us to maintain focus on the agreed objectives
- give early warning of potential problems
- set the expectations of, and manage the perceptions of key stakeholders.

For example, one possible KPI might be that a greater proportion of graduates joining the profession are non-maths majors. A corresponding KRI would be the average class of degree awarded to maths graduates joining the profession (the risk is that this falls). Any observed changes could be due to

factors external to the education system and so other information (e.g. surveys of new joiners) are also needed to identify causal factors.

Also important is the collection of information required to ascertain the effectiveness of new approaches to education. This is to enable us to answer questions such as:

- Why has the average pass rate for CA3 exams risen since the move away from a 'traditional' approach? Is it because the candidates have acquired a higher level of communication skills or, alternatively, is it because certain barriers have been removed?
- Has the FAP course assessment achieved a higher level of reliability and validity (whether this be content or another form) than its predecessors (Courses 5 and 6)?

When initiating new approaches to actuarial education it is important that we prepare at the outset to answer such questions. Effective feedback into problem specification and solution development is dependent upon having such answers. This is clearly a challenging and rich area for future research.

4. Professionalism and External Forces

The application of the control cycle places upon us the discipline of addressing the effect of external forces and the need to adopt professional standards.

The consideration of external forces should be made within each of the three main stages in the cycle. This paper does not attempt to make a comprehensive analysis but key forces include:

- globalisation
- changes in the demand for actuaries (that are beyond the control of the profession)
- growing competition from other professions
- competition between providers of education.

In terms of issues of professionalism, two factors are highlighted here:

- the need to be aware of the limits of ones own capabilities and seek the expertise of others, as appropriate. The actuarial qualification does not, of itself, provide individuals with the ability to develop optimal approaches to the education of actuaries!
- the management of potential conflicts of interest. Pursuing a control cycle approach will facilitate a more open discussion of such matters with a view to limiting their impact on the achievement of our objectives.

5. Conclusion

A broad review of the education of actuaries (Truckle, 1982) asked “whether the examination syllabus determines the actuary’s role; or whether the role should dictate the required syllabus”. A quarter of a century later, this question continues to be pertinent if it is applied not just to the syllabus but to the entire educational system.

The education system needs to develop systematically so as to help grow the demand for actuaries, broaden the areas in which they operate and meet the resulting demand. In particular, the current system is inefficient in its facilitation of higher-level learning. The actuarial control cycle can provide a useful discipline to the process of development.

Key areas for possible future development include:

- improved (‘smarter’) specification of higher-learning objectives, e.g. what is ‘business understanding’
- greater innovation in learning tools, e.g. to facilitate more meaningful interaction between distance learners
- wider adoption of well-situated experiential-learning techniques, e.g. PBL
- research into how changes in the education system have affected learning outcomes, e.g. the impact of the introduction of the FAP course.

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